

A black and white photograph of two oxen pulling a wooden cart in a rural setting. The oxen are harnessed together, and the cart is loaded with wooden poles. In the background, there is a small wooden structure and some trees.

# DEVELOPMENT ECONOMICS

THE ROLE OF  
AGRICULTURE  
IN DEVELOPMENT

P. N. (RAJA) JUNANKAR



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# Development Economics

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## The Role of Agriculture in Development

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DEVELOPMENT ECONOMICS: THE ROLE OF AGRICULTURE IN DEVELOPMENT

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To  
My wife, Susie, for her patience and support  
in producing this book  
For  
The millions of the poor in developing countries

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# Foreword

The papers on development gathered together by Raja Junankar in this volume bear witness to a critically minded, technically equipped, free spirit tackling one of the most important issues with which relevant economic analysis should be concerned. Junankar combines economic theory with case studies and econometric testing of theoretical inferences. He has a masterly understanding of theories of developing economies from Adam Smith to the present day. He starts by examining the effectiveness of dominant mainstream approaches in explanation and policy making. He finds them wanting and provides a rich narrative containing historical experiences, institutional change, voluntary and involuntary, and, most of all, the role of unequal power amongst decision-makers in explaining what has happened to all modes of production in both the world before the industrial revolution in Europe, dominated by the marauding imperial powers, and now the modern interrelated world economy, dominated by large multinational oligopolies.

Junankar's compassion and humanity shine through, his mind changes as evidence gathers and he firmly rejects the mainstream approach of "have model, will travel," to modestly assess what we know and what we do not know about complicated ongoing processes.

I learnt an enormous amount from his clearly expressed overall narrative and detailed papers and recommend the selection as required reading for students, teachers and policy makers.

**Professor Emeritus G. C. Harcourt**  
*School of Economics, UNSW Business School*

# Preface and Acknowledgements

As someone who came from a developing country (India), I have always had an interest in economic development. My interest in the subject has always been concerned with issues of social justice and equity. My initial research in this field was stimulated by some work I began with Professor (now Lord) Meghnad Desai on technical change in agriculture: this research never saw the light of day! Subsequently I was “intellectually assaulted” by Gunnar Myrdal’s *Asian Drama*. As I had been brought up on the pure milk of neoclassical economics at the London School of Economics, I found Myrdal’s work interesting but difficult to fit into a neoclassical paradigm. I decided, then, to try to formulate some of his hypotheses so that they were testable using neoclassical production theory. Over the years I have used applied econometric techniques on (mainly) Indian data. The Nuffield Foundation provided the financial assistance required during the early stages of my research. The University of Essex provided me with exceptionally good research and leave facilities. Over several years I taught Development Economics to undergraduate and graduate students at the University of Essex and I learned a lot from them. I supervised a few doctoral students at Essex and they helped to stimulate my understanding of other developing countries. Tony Atkinson provided much guidance and support. In the early years, Michael Lipton from the Institute of Development Studies at Sussex took an interest in my work and provided me with encouragement and help. Papers by Professor Amartya Sen have been an inspiration to me. My role on the editorial board of the *Journal of Development Studies* helped to enrich my knowledge.

As time moved on, I grew increasingly sceptical of neoclassical economic theory and my later papers reflect this. To what extent it is the empirical work, which rejected neoclassical economic theory, that changed my views is a difficult question in the philosophy of science. These negative results, I think, simply confirmed my increasing doubts about traditional neoclassical economic theory. In this collection of papers I have not provided any alternative theory or theories. I feel that what I have learned is humility: I (and I think *we*) know very little about what governs the behaviour of peasant farmers in less developed countries. Simple models are clearly inadequate. I have now come to the view that we need to know the historical, social, political and economic context within which people in developing countries operate. We need to incorporate these concepts into our empirical work to help us explain their behaviour.

This book is a selected collection of my published papers over many years that investigate development economics.

# 1

## Introduction

### The Role of Agriculture in Development

*“When the missionaries first came to Africa they had the Bible and we had the land. They said ‘let us pray’. We closed our eyes. When we opened them, we had the Bible and they had the land.” (Bishop Desmond Tutu).*

#### Introduction

Development Economics has moved over the decades from using an historical approach to using theoretical and mathematical approaches. Much of the literature used applied econometric methods to investigate various issues in Development Economics. In recent years, the growth of behavioural and experimental economics has led to the use of randomised control trials to investigate the effectiveness of various policies (World Bank, 2015). However, in the process of the development of the subject, we have lost the social, historical, and political context within which less developed countries (LDCs) operate. Economic development is a broader concept than economic growth. It entails not only an improvement in living standards on average (say in terms of GDP per capita) but also a lowering of poverty and inequality, an improvement in the educational, health and housing standards of people, and an increase in freedom and entitlements.<sup>1</sup>

In 2000, the United Nations set eight goals (the Millennium Development Goals, MDGs) for member countries to achieve by 2015. These eight goals were:

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality by two-thirds for children under five
5. Improve maternal health
6. Combat HIV and AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development.

The United Nations (2015) has just released its *Millennium Development Goals Report 2015*. It shows that extreme poverty has declined substantially; primary school enrolment has also increased; and there have been big improvements in gender equality. Child mortality has fallen by more than 50%. The maternal mortality rate has declined by 45%. There have been big improvements in health; improvements have been made to access to drinking water; and there has been improved sanitation. Official development assistance has increased by 66%.

However, this favourable picture hides huge disparities that exist in different countries and regions. Although global poverty has decreased significantly, mainly due to a huge improvement in China, there are a large number of people who still live in poverty in Africa and Asia.

Now LDCs (poor countries) work in a globalised world where international trade is carried out with limited tariffs, foreign investment is sometimes dominant, and domestic policies (taxation, labour market policies, and controls on capital) are restricted by international agreements and the dominance of large multinational oligopolistic companies. Although there are increasing pressures to introduce “free trade” in goods and services (usually in the form of bilateral treaties, rather than a truly free trade regime), there are very significant restrictions on the movement of labour. In the nineteenth century, if there was a famine in one country (e.g. Ireland), there would be a mass migration of people (to the USA): there was an escape valve. If there were wars and religious persecution, there would be significant migration waves to North America, the UK, and Australia. However, today, wars, famines and religious persecution overwhelmingly lead to poverty and homelessness.

Many developing countries were colonised in the nineteenth century and as a result their economies were transformed into producing goods for the colonial power. Some countries in Africa and South America became providers of raw materials (coal, iron, copper, etc.) for Britain and the US, while others became single-crop producers of tea, coffee, sugar, etc. for the colonial powers. Not only were the economies transformed, but so too were the social and cultural traditions. This historical legacy should not be forgotten when we study the development of these poor countries.<sup>2</sup>

## Stages of development

There is a large literature on countries going through specific stages of development. Marx, for example, argued that society goes from (a) “Asiatic production,” to (b) “Ancient production” (communal), to (c) feudal, to (d) capitalist production which would become increasingly monopolistic, and then due to the contradictions of a capitalist society, into (e) a socialist stage (see Junankar, 1982). Finally, when there are no more limits to the production of goods and services, society will move into a communist society.

A critical requirement to move from a simple mode of production where people produce for their own consumption is for technology to become more productive so that it can produce a surplus over that necessary for subsistence (see Kriesler, 2013). In a feudal society, the lord of the manor appropriated the surplus. Under capitalism, the capitalists appropriate the surplus and invest it in new capital goods which leads to an increase in production and profits (surplus).

Rostow (1960) proposed in his book *Five Stages of Economic Growth: A Non-Communist Manifesto* that development takes place in five stages:

- (i) Traditional Society,
- (ii) Preconditions for Take-Off,
- (iii) Take-Off,
- (iv) Drive to Maturity, and
- (v) Age of High Mass-Consumption.

Traditional society agriculture uses primitive technology. The social organisation was such that production was limited, and the society was primarily an agricultural society. The second stage had society becoming more dynamic with more education, new methods of production being employed, and the beginnings of manufacturing. The third stage of take-off occurred when saving and investment increased significantly, investment in infrastructure took place, and profits were reinvested in new methods of production, etc. The fourth stage, drive to maturity, was a long process where production continued increasing; saving and investment ratios increased to up to 20% of GDP; and new firms and industries were formed. The final stage, Age of Mass Consumption, which he took to be countries like Britain and the US, was one where modern technology had made production efficient and continuous. As this was a non-communist manifesto it is not surprising that he thinks of modernisation being simply dependent on saving and investment increasing without any consideration of what leads to the transition from one stage to another. This thesis has been criticised for not clearly demarcating each “stage” and the process by which the change takes place from one stage to another (see Thirlwall, 2011). In particular, many of the LDCs of today are not operating under the same conditions that (say) Britain or the USA were, since they are affected by the existence of large multinational corporations, and globalisation.

To really identify how societies progress, we need to study the development of an economy that is initially producing agricultural goods mainly for subsistence. At this stage the farmers are not producing a “surplus” that they can engage in trade with others. Early classical economists like Adam Smith, David Ricardo and Karl Marx had emphasised the crucial role of producing a surplus beyond the needs of the population. In much of classical economics, wages were kept at subsistence, either through population growth or



through unemployment, which allowed the capitalist to obtain a potential surplus from production. How the surplus was then realised and distributed obviously depended upon the social forms of production. In general, in a capitalist society the surplus is invested in capital goods to increase profits. For Malthus and Ricardo, with diminishing returns in agriculture, the share of the surplus falls and hence investment slows down until society reaches a stationary state. Technical progress in agriculture is a temporary means of delaying the stationary state. For Marx, the surplus created in production is invested, usually in the newest capital goods, hence increasing the surplus in the future. In the process of investment, unemployment (the Industrial Reserve Army) is created as investment is in labour-saving technology, which then puts downward pressure on wages. Eventually, Marx argued, there is a falling rate of profits (as did Ricardo, for a different reason) which slows down investment (accumulation).

It is important to remember, however, that the LDCs are now in a completely different economic environment from that faced by the industrial market economies (say) a hundred years ago. Poor countries have been transformed by colonial activities and are now working in a globalised world with large powerful multinational oligopolistic corporations (see Harcourt and Nolan, 2009). Hence, some of the stylised models of development may not be applicable to the LDCs that are developing today.<sup>3</sup>

In my opinion, it is possible to think of four phases that LDCs have been going through. The *first* phase is one where they existed in relative isolation from many other countries with little international trade. In fact, most pre-capitalist societies engaged in international trade: Venetian traders went far and wide, as did Arab traders. The *second* phase is one of colonisation where Western European countries, such as the UK, France, Holland, and Spain, colonised large parts of Asia, South America, and Africa. In this phase there was a complete transformation of the economy into producing goods for exports to the colonial power. In this phase, colonialism introduced new forms of land tenure, disrupted old established agricultural practices, introduced plantation systems, expropriated fertile lands for the white settlers, changed the labour market systems (e.g. introduced indentured labour), and introduced market/capitalist systems. Subsistence agriculture was replaced by the production of cash crops for exports, and minerals were extracted for exports. This led to the colonial economies becoming completely reliant on single-plantation crops or single-commodity production, and the production of subsistence crops suffered. During this process, the surplus was usually exported to the colonial power and there were few interlinkages with other parts of the economy.

The *third* phase was one of liberation from colonial domination (see Acemoglu et al., 2001). In the early stages, the 1950s, and 1960s, some of these newly independent countries introduced “import substitution” policies with tariff walls. However, in some ways all that had changed was that

instead of rich colonials exploiting the resources, it was now the emancipated bourgeoisie. Over time these countries began importing luxury goods for their elites and this led to balance of payments problems. Eventually, they were forced to devalue their currencies, go cap in hand to the International Monetary Fund for loans which were granted with significant conditions ("Structural Adjustment") that included lowering tariffs, cutting subsidies for the poor, and freeing up the country for international capital.

The *fourth* phase was one of the growth of multinational firms. In some poor countries, governments went out of their way to entice foreign capital by providing tax concessions (or tax holidays) to foreign capital. Foreign capital was happy to invest in these countries as labour was much cheaper and more "disciplined" than in the developed countries. Trade unions were weak and their activities were limited by governments keen to invite foreign capital. This was a period of "footloose" capitalists: when wages in one country started increasing as development proceeded, they simply moved to another country. At one time multinationals were producing in Japan, then South Korea, Taiwan, Bangladesh, and now China, Vietnam, and Indonesia.

## Dual economy models

In 1954, Lewis produced a seminal paper on a dual economy model. In this model there are two sectors: a modern capitalist (industrial) sector and a traditional subsistence (agricultural) sector. The traditional sector has "unlimited" supplies of labour (a very large population) where wages are at subsistence. Agricultural production remains unchanged as workers move out to the industrial sector, there is surplus labour (disguised unemployment)<sup>4</sup> in agriculture. Capitalists in the modern sector reinvest all their profits and hence in the next period they can increase production, employment increases, profits increase, reinvestment takes place and the system continues to grow.

This was a very attractive model for a long time as it appears that we can have something for nothing: agricultural production remains constant as workers move out to the modern sector, while industrial production increases with increased employment and investment.<sup>5</sup>

In many of these models agriculture is simply treated as a sector that is there to produce goods and provide labour for the dominant sector, the industrial sector. Eventually, when the unlimited supply of labour is exhausted wages in the industrial sector would rise, hence slowing down employment and profits. Subsequently, capitalists would continue to reinvest profits and the economy would continue to grow. For Lewis the economy switches from a classical model to a neoclassical one.

Of course, what happened in many developing countries is that there was a mass movement of labour from the agricultural sector to the urban industrial areas that created unemployment, homelessness, slums, and poverty. The industrial sector could not absorb the large number of migrants.

This led to the development of an important model of migration by Todaro (1969) and Harris and Todaro (1970) where rural–urban migration was not only attracted by the higher wages in the urban areas but conditioned by the probability of finding a job. Hence, if large-scale migration took place to the urban area, unemployment would rise and hence slow down future migration.

In recent years in China, there has been a massive rural–urban migration that has helped to develop the urban industrial sector that is export-oriented. However, rural–urban migration is strictly controlled so it has not led to urban unemployment and the growth of slums.

## **Land reforms and agricultural development**

For many poor countries land reforms have preceded economic development, for example, Japan and Korea. However, there have been demands for land reforms in many countries in Latin America and Asia. In India various land reforms have been introduced and their success has been limited in expanding agricultural production, partly because of powerful interests that frustrated the land reforms.

The basis for many of these land reforms was some controversial research that showed that small farms were more efficient than large farmers. The underlying reasons for this were that small farmers dedicated much “tender loving care” to their land and since they were very poor, they tried to produce as much as possible per hectare of land, while large farmers were trying to maximise profits. Further, there was evidence that tenants (especially share croppers) with short-term leases did not invest in improving the land and hence had lower productivity than small owner farmers (see Chapters 2.1, 2.2, 4.1, 4.2, 4.3, and 4.4). Feudal landlords have much power and influence in rural agriculture that prevents economic development (see Anderson et al., 2015; Bhaduri, 1973).

## **Why is agriculture important?**

In much of the earlier literature, the agricultural sector was seen simply as a means to the process of industrialisation rather than of interest in its own right. It was seen simply as a source of providing a surplus of food for the industrial labour force, providing raw materials (e.g. cotton for the textile industry, rice and wheat for milling, etc.) for industrial production, a cheap source of labour for the capitalist industrial sector, and foreign exchange to import capital goods for the industrial sector.

This picture of a subservient backward agricultural sector was changed in the *World Development Report 1982* by the World Bank (1982) when it was argued that agriculture was important in and of itself as it had a large population dependent on it and often living conditions were poor.<sup>6</sup> It was

important to introduce technological change in agriculture to make it more productive. More than two decades later, the World Bank (2008) in its *World Development Report 2008*<sup>7</sup> argued that agriculture can be an engine of growth and a force for poverty reduction.

One of the fairly well-documented generalisations is that during the process of economic development there is a secular decline in the relative importance of the agricultural sector (see Tables 1.1, 1.2, 1.3, and 1.4). What has been observed is that the share of agricultural output in GDP declines and

*Table 1.1* Share of agriculture in GDP and total employment (developing countries)

|                                       |                 | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 |
|---------------------------------------|-----------------|------|------|------|------|------|------|
| <b>East Asia &amp; Pacific</b>        | Agri (% of GDP) | 24.9 | 19.1 | 14.6 | 11.9 | 10.6 | 10.2 |
| <b>East Asia &amp; Pacific</b>        | Agri Emp (%)    | ..   | 50.8 | 49.6 | 44.0 | 36.7 | ..   |
| <b>Europe &amp; Central Asia</b>      | Agri (% of GDP) | 20.7 | 18.2 | 13.3 | 11.0 | 9.1  | 8.6  |
| <b>Europe &amp; Central Asia</b>      | Agri Emp (%)    | ..   | 34.7 | 34.3 | 28.3 | ..   | ..   |
| <b>Latin America &amp; Caribbean</b>  | Agri (% of GDP) | 9.3  | 6.8  | 5.6  | 5.4  | 5.0  | 5.2  |
| <b>Latin America &amp; Caribbean)</b> | Agri Emp (%)    | ..   | 21.1 | ..   | 21.1 | ..   | ..   |
| <b>Middle East &amp; North Africa</b> | Agri (% of GDP) | 18.1 | 16.2 | 13.3 | 10.6 | ..   | ..   |
| <b>Middle East &amp; North Africa</b> | Agri Emp (%)    | ..   | ..   | ..   | ..   | ..   | ..   |
| <b>South Asia</b>                     | Agri (% of GDP) | 29.0 | 26.3 | 23.4 | 19.2 | 18.9 | 18.6 |
| <b>South Asia</b>                     | Agri Emp (%)    | ..   | ..   | 59.2 | 53.5 | 50.8 | ..   |
| <b>Sub-Saharan Africa</b>             | Agri (% of GDP) | 21.0 | 19.7 | 17.1 | 17.1 | 15.1 | 14.2 |
| <b>Sub-Saharan Africa</b>             | Agri Emp (%)    | ..   | ..   | ..   | ..   | ..   | ..   |

*Table 1.2* Share of agriculture in GDP and total employment

|                                |                 | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 |
|--------------------------------|-----------------|------|------|------|------|------|------|
| <b>Low income</b>              | Agri (% of GDP) | 41.1 | 41.9 | 34.7 | 33.8 | 33.7 | 32.7 |
| <b>Low income</b>              | Agri Emp (%)    | ..   | ..   | ..   | ..   | ..   | ..   |
| <b>Low &amp; middle income</b> | Agri (% of GDP) | 20.6 | 16.7 | 13.5 | 11.4 | 10.4 | 10.3 |
| <b>Low &amp; middle income</b> | Agri Emp (%)    | ..   | ..   | 49.2 | 44.5 | 38.4 | ..   |
| <b>Lower middle income</b>     | Agri (% of GDP) | 26.9 | 24.4 | 21.5 | 18.0 | 17.3 | 17.0 |
| <b>Lower middle income</b>     | Agri Emp (%)    | ..   | ..   | 54.0 | 49.8 | 45.9 | ..   |
| <b>Middle income</b>           | Agri (% of GDP) | 20.3 | 16.4 | 13.2 | 11.1 | 10.1 | 10.0 |
| <b>Middle income</b>           | Agri Emp (%)    | ..   | ..   | 49.1 | 43.4 | 38.3 | ..   |
| <b>Upper middle income</b>     | Agri (% of GDP) | 17.9 | 13.6 | 10.3 | 8.7  | 7.6  | 7.5  |
| <b>Upper middle income</b>     | Agri Emp (%)    | ..   | 46.2 | 45.0 | 38.5 | 33.0 | ..   |
| <b>High income</b>             | Agri (% of GDP) | ..   | ..   | 1.9  | 1.6  | 1.5  | 1.6  |
| <b>High income</b>             | Agri Emp (%)    | ..   | 6.9  | 6.0  | 4.7  | 3.5  | ..   |

Source: World Bank, World Development Indicators.

Table 1.3 Rural population (%) and poverty (headcount at \$2.00 per day, %; Developing Countries)

|                            |                      | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 |
|----------------------------|----------------------|------|------|------|------|------|------|
| East Asia & Pacific        | Rural population (%) | 71.8 | 67.8 | 63.4 | 57.8 | 52.3 | 49.1 |
| East Asia & Pacific        | Poverty (%)          | 81.5 | ..   | ..   | 38.4 | 26.4 | ..   |
| Europe & Central Asia      | Rural population (%) | 43.6 | 43.1 | 42.8 | 41.9 | 40.9 | 40.3 |
| Europe & Central Asia      | Poverty (%)          | 6.3  | ..   | ..   | 4.6  | 2.4  | ..   |
| Latin America & Caribbean  | Rural population (%) | 32.3 | 29.6 | 27.1 | 25.2 | 23.6 | 22.6 |
| Latin America & Caribbean) | Poverty (%)          | 22.6 | ..   | ..   | 15.2 | 9.8  | ..   |
| Middle East & North Africa | Rural population (%) | 48.3 | 46.4 | 44.5 | 42.6 | 40.9 | 39.9 |
| Middle East & North Africa | Poverty (%)          | 23.8 | ..   | ..   | 17.2 | 11.7 | ..   |
| Sub-Saharan Africa         | Rural population (%) | 73.0 | 71.0 | 69.3 | 67.2 | 64.8 | 63.3 |
| Sub-Saharan Africa         | Poverty (%)          | 76.0 | ..   | ..   | 74.5 | 70.6 | ..   |
| South Asia                 | Rural population (%) | 75.0 | 73.8 | 72.6 | 70.9 | 69.0 | 67.8 |
| South Asia                 | Poverty (%)          | 83.7 | ..   | ..   | 73.3 | 64.7 | ..   |

Table 1.4 Rural population (%) and poverty (headcount at \$2.00 per day, %)

|                     |                      | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 |
|---------------------|----------------------|------|------|------|------|------|------|
| Low income          | Rural population (%) | 78.0 | 76.4 | 75.2 | 73.7 | 72.0 | 70.8 |
| Low income          | Poverty (%)          | 85.3 | ..   | ..   | 80.2 | 74.9 | ..   |
| Low & middle income | Rural population (%) | 66.3 | 63.9 | 61.4 | 58.4 | 55.3 | 53.5 |
| Low & middle income | Poverty (%)          | 64.8 | ..   | ..   | 46.5 | 39.0 | ..   |
| Lower middle income | Rural population (%) | 70.1 | 68.7 | 67.1 | 65.3 | 63.2 | 61.9 |
| Lower middle income | Poverty (%)          | 74.1 | ..   | ..   | 62.5 | 54.5 | ..   |
| Middle income       | Rural population (%) | 65.3 | 62.7 | 60.1 | 56.8 | 53.5 | 51.5 |
| Middle income       | Poverty (%)          | 66.3 | ..   | ..   | 44.7 | 36.1 | ..   |
| Upper middle income | Rural population (%) | 60.4 | 56.5 | 52.3 | 47.2 | 42.1 | 39.1 |
| Upper middle income | Poverty (%)          | 59.4 | ..   | ..   | 27.1 | 17.1 | ..   |
| High income         | Rural population (%) | 25.2 | 24.1 | 23.1 | 21.5 | 20.2 | 19.6 |
| High income         | Poverty (%)          | ..   | ..   | ..   | ..   | ..   | ..   |

Source: World Bank, World Development Indicators.

the share of employment in agriculture falls relative to total employment. For many LDCs, agriculture is a dominant sector in terms of the share of GDP produced and in terms of the share of employment (unfortunately, data are difficult to obtain on agricultural employment, but the data on rural population provide a good indicator<sup>8</sup>). As these tables show, agriculture provides a large proportion of GDP for poorer countries, and the share of the rural population is very high and falling slowly. It is noticeable that poverty rates are incredibly high in poorer countries.

For the agricultural sector to expand production and productivity, it needs to modernise its methods of production which requires better irrigation facilities; better and cheaper fertilisers (preferably those that do not harm the environment); better transport to markets; improved technology (which includes HYVs); and better and more capital goods (a move from the bull-ock cart to the tractor). Investment in agriculture is critical to increasing

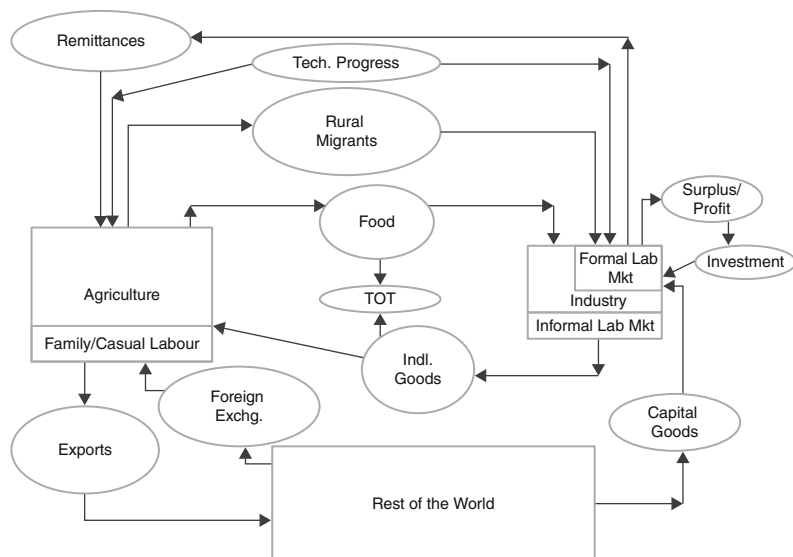
production, productivity and employment in agriculture, and hence lowering poverty in the rural sector. Improvements in education, increased human capital, would also help agricultural improvements in terms of knowledge about better farming techniques, better knowledge about irrigation and fertilisers.

In an ideal world, as the industrial sector expands it provides a market for the agricultural sector, but also provides capital goods (tractors etc.) to the rural sector, and this could in a process of cumulative causation<sup>9</sup> lead to a growing economy.

In general, as the agricultural sector declines relatively, industry expands both absolutely and in relative terms. During this process of development the services sector begins to expand and in some developed countries the service sector becomes the dominant sector. Unusually, in India the process of development seems to have missed the growth of the industrial sector and the services sector has been expanding rapidly.

During the process of development, the surplus produced in agriculture provides food for the industrial labour force, it provides aggregate demand for industrial products (at least by the richer agricultural class), it provides labour to the industrial sector via rural-to-urban migration, and by exports of primary products it provides foreign exchange to the economy. Migrants to the urban industrial sector also provide remittances to their families in the agricultural sector and hence help to increase the demand for industrial products.<sup>10</sup> The terms of trade (TOT, the price of agricultural goods relative to industrial goods) then depends on the strengths of the demand for industrial products by the agricultural sector and the demand for food by the industrial sector. Of course, in a globalised world, agricultural prices are determined in international markets.

Figure 1.1 illustrates the various levels of backward and forward linkages between the agricultural and industrial sectors, and with the rest of the world. For some countries that produce cash crops (e.g. coffee, tea, sugar, etc.), foreign exchange obtained provides the means to purchase foreign capital goods for the industrial and agricultural sectors. In the figure, we also show that much of the labour employed in agriculture tends to be family labour with some hired wage labour. Often the small farmers employ hired wage labour only in peak seasons like the sowing and harvesting seasons. In the industrial sector, labour is hired either on a formal basis or on a casual temporary basis. Although the figure has listed the two sectors as agriculture and industry, they could also represent the rural and urban sectors. In the urban sector much of economic activity comes under the umbrella of informal markets (e.g. selling cigarettes, etc. on the street or tea-shops along the street). Those employed in the informal sector are often petty traders, or employed family members, or others employed on a casual basis. Many rural-to-urban migrants often end up working in the informal labour market, and eventually hope to be employed in the higher wage formal



*Figure 1.1* Linkages between agricultural and industrial sectors

The International Labour Organisation (ILO) defines vulnerable employment as the proportion of workers who are own-account workers and contributing family members (unpaid) in total employment. This group of workers is subject to economic risk, and work in areas where institutional arrangements (social protection, job security etc.) are very weak. Table 1.5 shows the big differences in vulnerable employment between the richer and poorer groups of countries. As development proceeds, vulnerable employment decreases in most countries. It is interesting to note that the LDCs that have a large proportion of agricultural workers are also likely to have a high proportion of vulnerable employment. For example, vulnerable employment in South Asia is 76%, while in developed economies it is only 10%.

A prosperous agricultural sector helps to decrease rural poverty, increase demand for products from the urban industrial sector, and also lowers the rate of rural-to-urban migration. The extent to which improvements in agriculture help lower poverty and increase demand for urban goods depends on income distribution in the rural sector. The less unequal the distribution of income, the greater the demand for industrial goods and hence the greater is the favourable impact on the urban industrial sector. However, as food prices increase (which is good for the agricultural sector) wages in the

Table 1.5 Vulnerable employment

|                                                              | 1995 | 2000 | 2005 | 2010 | 2013 |
|--------------------------------------------------------------|------|------|------|------|------|
| <b>Developed Economies &amp; European Union</b>              | 12.3 | 11.3 | 10.9 | 10.3 | 10.1 |
| <b>Central &amp; South-Eastern Europe (non-EU) &amp; CIS</b> | 22.1 | 22.5 | 21.3 | 20.0 | 19.6 |
| <b>East Asia</b>                                             | 64.5 | 58.2 | 54.5 | 48.6 | 44.8 |
| <b>South-East Asia &amp; the Pacific</b>                     | 66.9 | 65.7 | 61.9 | 60.7 | 59.1 |
| <b>South Asia</b>                                            | 83.2 | 80.9 | 80.7 | 78.5 | 76.2 |
| <b>Latin America &amp; the Caribbean</b>                     | 36.5 | 35.4 | 33.4 | 31.7 | 31.8 |
| <b>Middle East</b>                                           | 34.9 | 32.1 | 29.5 | 25.3 | 24.6 |
| <b>North Africa</b>                                          | 40.4 | 39.4 | 41.1 | 36.8 | 37.1 |
| <b>Sub-Saharan Africa</b>                                    | 79.6 | 78.5 | 78.4 | 77.8 | 77.4 |

Source: ILO, KILM Trends Estimation Model.

industrial sector are likely to increase, which results in lower profitability in the industrial sector. But, as wages in the industrial sector rise, workers efficiency could increase due to the nutritional benefits of higher incomes, which would act as an offsetting factor against the higher costs of wages.<sup>11</sup> Higher wages also lead to a lower rate of labour turnover as workers are happy in their workplace and hence there is increased productivity. In the literature this is referred to as the “efficiency wage hypothesis.”

## Technology and agriculture

In most of the models of development, agriculture is considered to be a slow-growing sector in terms of productivity, while industry is more rapidly growing due to economies of scale and improved technology. As a result, many economists argued that “industry” is the sector that should be favoured by policymakers to increase the growth rate of the economy. In fact, although the industrial sector has been expanding rapidly in many LDCs, employment has not risen in tandem. This concentration on growth first with the hope that the benefits of this growth would “trickle down” to the poorer sections of society has now been debunked by a recent study by the IMF (2015), which states that

if the income share of the top 20% (the rich) increases, then GDP growth actually declines over the medium term, suggesting that the benefits do not trickle down. (Dabla-Norris *et al.*, 2015, p. 4)

Improved technology made a big impact on agriculture through the Green Revolution (the use of High Yielding Varieties of seeds, HYV). In countries like India, agricultural production and productivity increased substantially helping to decrease rural poverty, although the gains were distributed unequally (see Chapters 3.2 and 3.3).



In some work on a possible trade-off between employment and productivity, I (Junankar, 2015) found that there was an inverse relationship between employment growth and productivity growth. This suggests that simply increasing the growth rate by better capital and better technology does not lead to better employment growth. Hence, the poor are not necessarily going to benefit from productivity growth.

## **Agriculture and the environment**

Since the 1960s, agricultural production in poor countries has been transformed by the introduction of new technology: the Green Revolution technology in (say) India, and the use of genetically modified organisms (GMOs) that has been associated with the increasing power of multinationals that produce these new seeds. While these GMO seeds are more productive, the farmers are required to purchase seeds for their next crop: they are not allowed to save seeds from their crop for subsequent seeding. As such they are forced to enter into market relations that are clearly unequal.

For several decades with the rise of the Green Revolution (use of HYV seeds) there has been a big increase in the use of fertilisers and pesticides. This has led to serious issues of water and soil contamination leading to problems of disease and ill health amongst farmers. As this Green Revolution technology requires frequent and regular irrigation (usually using water from tube wells), it has led to the water table being depleted, and led to arsenic in drinking water.

In recent years, there has been a big move to replace petroleum by bio-fuels leading to a huge expansion in the growth of corn, soybeans, and sugarcane displacing crops for consumption as food. This has put upward pressure on food prices and hence led to problems for many developing countries that import food. In addition, since there is a global food market, the poor in LDCs now face increased food prices; at the same time there has been pressure from international agencies to lower subsidies on food for the poor.

Another impact of the growth of farming has led to the destruction of forests, which leads to a decrease in the absorption of carbon dioxide gases, and hence may be contributing to climate change. As some countries have become richer, for example China, they are consuming more meat products. This has increased the demand for livestock farming, which is affecting the environment by the increase in methane released by cattle, also damaging the environment.

## **Overview of the chapters**

### **Land Tenure, Agricultural Productivity, and Taxation**

#### *Chapter 2.1 Land Tenure and Indian Agricultural Productivity*

This is the first of a set of papers using econometric methods on cross-section Farm Management Studies data. This paper uses Farm Management Studies data from the Ferozepur district of Punjab (North India) for 1968–1969 and

1969–1970. This is an important region of India since it was the heartland of the so-called Green Revolution in wheat production in India. In this paper I used econometric methods to study two issues: (1) whether there was an inverse relationship between farm size and productivity, and (2) whether tenant farmers were less efficient than owner farmers. Both these issues are important for an economic justification for land reforms. Although much work had been done on size and productivity, very little work had been done on tenancy and efficiency. The paper used Ordinary Least Squares to estimate Cobb–Douglas production functions for different groups of farmers (owners versus tenants, small versus large, etc.) and tested for differences between the groups. In addition, tests were carried out for structural stability over time. Our results suggest that there were significant differences between small and large farms which were captured by estimating separate production functions (a simple multiplicative shift dummy was inappropriate). We found that the vector of parameter estimates of small farms did not dominate (nor dominated by) that of large farms. However, we found that for large farms the greater is the degree of tenancy the lower the production. On the tenancy issue we found significant differences between production functions for owners and tenants. Overall we found that owners were more productive than tenants. Thus the results of this paper provide some economic justification for land reforms. In another paper (see Chapter 2.2) it is argued that land reforms would also be equitable.

The main contribution of this paper was in formulating hypotheses about (a) size and productivity and (b) tenancy and productivity, and using econometric methods to test them.

### *Chapter 2.2 Land Ceilings as a Tax on Agriculture: A Note*

This is a brief note that argues that we should analyse land ceilings in a public finance context. In most states of the Indian Republic, legislation has been passed imposing ceilings on the amount of land that can be held by an individual (or family). My note suggests that a land ceiling is equivalent to a wealth tax and as such desirable both on equity and efficiency grounds. This relies on the empirical observations that agricultural incomes are virtually untaxed (while urban incomes are taxed) and that small farmers are more (technically) efficient than large farmers. In the note I ignored the problem of compensation and how the government would finance this compensation. The contribution of this note was to suggest an analytical structure for this problem.

### *Chapter 2.3 Review of Palanpur: The Economy of an Indian Village*

This review looks at a book that makes an important contribution to the literature on Development Economics by two leading theoretical economists who spent several months in an Indian village. This book by Bliss and Stern (1982) is an interesting study of farmers in a rural village in Uttar Pradesh (India).

In their study they argue that farmers can be considered to be agents maximising under uncertainty. The review is critical of the neoclassical assumptions of maximising behaviour when markets are imperfect and institutional and social constraints are very important. In fact, one of the authors, Professor Lord Stern, went on to continue this field work and published another book with another colleague Lanjouw (Lanjouw and Stern, 1998).

#### *Chapter 2.4 Agricultural Taxation in LDCs: Effects of a Tax on Inefficiency*

In this chapter we recommend a tax that could be imposed on “farmer inefficiency” (the difference between the farmer’s production level and some potential output level). This tax would lead to increased production. The argument is based on a simple model where wealthier farmers use some of their money for money-lending purposes rather than for agricultural production. The tax on inefficiency would then lead to less money-lending and more agricultural production.

### **Poverty, Mobility and Inequality**

#### *Chapter 3.1 Poverty in India: A Comment*

This chapter assesses the possibility of funding a massive public works programme by raising taxes on the rich. It is argued that the tax increases required would be massive and unlikely to be legislated or realised in a society where the rich are powerful and can frustrate political moves.

#### *Chapter 3.2 The Green Revolution and Inequality*

This paper investigates changes in income and wealth inequality for a longitudinal sample of farmers in the Ferozepur district of Punjab which was the “heartland” of the Green Revolution in India. The paper describes inequality of income and wealth (as measured by land owned, by “operational holding” and by net cultivated area). For both years 1968–1969 and 1969–1970 it is found that inequality of income (as measured by the Gini coefficient) is greater than inequality of wealth. Further, inequality of land ownership is greater than inequality of “operational” holdings or net cultivated area. Inequality of wealth is observed to increase marginally while inequality of income declines marginally. In a subsequent section Atkinson’s inequality index is used to discuss the degree of inequality. Finally, an attempt is made to see which farms move up or down the “agricultural ladder.” These results suggest a fair bit of mobility in the sample.

#### *Chapter 3.3 Mobility and Inequality in Indian Agriculture*

This chapter investigates movements of inequalities of income and wealth using regression techniques on panel data. In particular it studies the extent to which mobility explains changing inequalities. It finds that mobility led

to a small increase in inequality. Curiously, we found that success does not breed success. Farmers that are successful in one period are not successful in the next period.

## **Do Farmers in Developing Countries Maximise Profits?**

### *Chapter 4.1 Tests of the Profit Maximisation Hypothesis*

In this paper I used Lau and Yotopoulos's (1971, 1973) model for testing for differences between production and market behaviour of small (tenant) and large (owner) farms. I also test the appropriateness of a profit-maximising competitive model for the Ferozepur district of Punjab (North India). Ostensibly, this is a region of go-ahead enterprising farmers who had introduced the new Green Revolution technology, so this provided a good data sample for testing neoclassical economic theory. From an econometric point of view the Lau-Yotopoulos methodology (using duality theory) allows us to test for differences in technical and price efficiency between different groups of farmers. Using the Farm Management Studies data for one crop ("Mexican Wheat") and allowing for *one* variable input (labour) in a Cobb-Douglas framework I tested this model. Using alternative definitions of profit and capital, the model was estimated by Zellner's Seemingly Unrelated Regression method. The results suggest that the model is mis-specified since a key variable (the real wage rate) comes out with the "wrong" sign (profits increase with real wages). Ignoring this problem, there were no significant differences between different groups of farmers. A section of the paper discusses "alibis" – why the rejection of the model may be due to other factors. *Inter alia*, it is mentioned that a properly specified model should allow for more inputs and for different functional forms. In two subsequent papers I generalised this paper to allow for more variable inputs and for a flexible functional farm.

The contribution of this paper is a rigorous testing of a model of farm behaviour which allows for differences in technical efficiency and price efficiency for different groups of farmers. The paper also discusses various conceptual problems of production and profit functions.

### *Chapter 4.2 Do Indian Farmers Maximise Profits?*

In this paper I used the Lau-Yotopoulos model (again in a Cobb-Douglas framework) with some modifications to test the hypothesis of profit-maximising behaviour under competitive conditions. The data for this paper are from a rice-growing area in the Thanjavur district of Tamil Nadu (South India) for 1969–1970. This was also a region where new improved HYVs were being employed. The sample thus allows us to test the model on a different region of India growing a completely different crop. This paper modifies and extends the approach of the previous paper. In particular we allow for differences in the *timing* of inputs by including two

kinds of labour. These two kinds of labour are family and annual farm servants on the one hand, and casual hired labour on the other. We postulate that casual hired labour is employed only in the peak seasons while family (and annual farm servant) labour is used in fixed proportions in peak and slack seasons. (Given the available data this was the only way for allowing for the *timing* of the labour input). We also state that these two kinds of labour might also reflect *quality* differences: family labour providing more “loving care” to the land. In addition we have bullock labour as a variable input. The other modification to the previous paper is to set up the model in an alternative form which allows us to pinpoint *which* variable(s) satisfy our *a priori* sign restrictions.

The model was estimated by Zellner’s Seemingly Unrelated Regressions Estimation method imposed within and across equation constraints. The model was estimated for two crop seasons but the results were similar. Overall the results reject the profit function model even though it allows for consistent non-profit-maximising behaviour. Thus even in the South of India for a region which is well irrigated, where farmers are using new varieties of seeds, a competitive (static) neoclassical model is inappropriate. The tests reject the profit function model.

#### *Chapter 4.3 Neoclassical Economics and Indian Agriculture*

This paper extends the earlier work studying the behaviour of farmers in India. It begins with a discussion of neoclassical economic theory and some of its critics. This paper uses a translog profit function on Farm Management Studies data for the Thanjavur district of Tamil Nadu (South India). In earlier work I had used a Cobb-Douglas production and profit function and hence the results rejecting a neoclassical maximising model could have arisen because of using a restrictive functional form. In this paper, even with a flexible functional form (which provides a second-order approximation to any twice differentiable function) the data reject the model. In a penultimate section I discuss the reasons for the rejection of a neoclassical model. Various institutional constraints and “imperfections” suggest that a traditional neoclassical model for competitive markets is inappropriate. Even if we allowed for (multiplicative) uncertainty the model would be rejected since we reject consistency and symmetry. Although we believe uncertainty is important, we feel that the model is rejected due to the inappropriateness of the assumptions of neoclassical economics for the data samples we have chosen. We conclude that we need to model economic behaviour by taking account of the institutional constraints which limit the choices available to small farmers. Large farmers, in contrast, are in a dominant position and affect the behaviour of small farmers. We believe that the interlinking of factor markets limits the value of a simple neoclassical model.

### *Chapter 4.4 The Response of Peasant Farmers to Price Incentives*

This chapter evaluates critically the debate between economists who advocate *laissez-faire* markets and institutionalists. It assesses the various estimates provided in the literature that claim that farmers are good maximising agents facing given prices. The chapter argues that farmers in LDCs do not face competitive markets with given prices, but are constrained by historical, social, institutional features of an economy. Rich farmers operate in a different world from poor farmers: they have access to better technology, more markets, cheaper credit, and can and do influence the prices of inputs and outputs.

## **Informal Labour Markets**

### *Chapter 5.1 The Informal Labour Market in India*

The informal sector is a very important part of developing economies. In the famous Lewis model of development, workers move from the agricultural sector to the industrial sector and help to expand the economy. Unfortunately, although thousands/millions of rural people move to the urban sector most of them do not find employment in the advanced industrial sector. They find employment in the informal sector where incomes and conditions of work are poor. If they are lucky they may eventually end up in the formal sector at better wages and conditions. In this study we find that most of the people in the informal sector come from lower social castes and religions. In general informal sector incomes are lower than formal sector earnings. We find evidence to support the view that the longer a migrant has been in the urban sector, the more likely he or she is to get formal sector employment.

## **Microfinance and women's empowerment**

### *Chapter 6.1 Factors Influencing Women's Empowerment on Microcredit Borrowers: A Case Study in Bangladesh*

A Nobel Prize winner Muhammad Yunus, who has started the Grameen Bank in Bangladesh, has been a trailblazer in the use of microfinance to help the poor, especially women, in developing countries to establish themselves in small-scale enterprises. This chapter, using original data from Bangladesh, finds that women who are borrowers from the Grameen Bank or BRAC (formerly known as the Bangladesh Rural Advancement Committee) are more empowered than other women.

## **Acknowledgements**

I am grateful to G.C. Harcourt and Peter Kriesler for helpful comments on an earlier draft that helped to improve this chapter. Needless to say, I am responsible for any remaining errors.

## Appendix 1.1

*Table A1* Share of employment in agriculture (%)

|                                               | 1995 | 2000 | 2005 | 2010 | 2013 |
|-----------------------------------------------|------|------|------|------|------|
| Developed Economies & European Union          | 6.4  | 5.5  | 4.3  | 3.8  | 3.6  |
| Central & South-Eastern Europe (non-EU) & CIS | 27   | 25.3 | 20.9 | 18.3 | 17.7 |
| East Asia                                     | 49.7 | 47.6 | 42.5 | 34.9 | 30.3 |
| South-East Asia & the Pacific                 | 52.5 | 49.8 | 45.8 | 41.4 | 39.3 |
| South Asia                                    | 60.7 | 59.5 | 53.9 | 50.4 | 46.3 |
| Latin America & the Caribbean                 | 24.4 | 20.1 | 19.5 | 10.8 | 14.8 |
| Middle East                                   | 24   | 22.9 | 20.4 | 15.3 | 14.3 |
| North Africa                                  | 35.9 | 33.9 | 33.5 | 30.1 | 28   |
| Sub-Saharan Africa                            | 65.7 | 65   | 63.9 | 62.6 | 62   |

*Source:* ILO, KILM.

## Appendix 2

United Nations 2000<sup>12</sup>

### **What are the Millennium Development Goals?**

The Millennium Development Goals (MDGs) are a set of eight goals set by 191 United Nations member countries that have the goal of halving world poverty by the year 2015.

The goals are:

#### 1. Eradicate extreme poverty and hunger

This goal calls for reducing by half the proportion of people living on less than \$1 a day. It also calls for halving the proportion of people who suffer from hunger.

- Around 1 billion people live on less than \$1 per day
- 800 million people go hungry every day
- While there are some poor countries who are on course for achieving goal 1, most of the poorest countries especially in Africa are falling well behind the targets

#### 2. Achieve universal primary education

The target is for all children, boys and girls, to complete a full course of primary schooling.

- 133 million young people cannot read or write
- Only 37 of 155 developing countries have achieved universal primary school completion
- If current trends persist, children in more than half of the developing countries will not complete a full course of primary education in 2015

#### 3. Promote gender equality and empower women

To eliminate gender disparity in primary and secondary education.

- Two-thirds of the world's illiterate people are female
- Women only held 15% of seats in national parliaments in 2003

4. Reduce child mortality by two-thirds for children under five  
This goal is to reduce the 1990 under-five mortality rate by two-thirds.

- Over 9 million children under the age of five die each year, mostly from preventable diseases
- Very few developing countries are on track to achieve the two-thirds reduction in mortality rates

5. Improve maternal health  
Reduce by three-quarters the maternal mortality ratio.

- Of the 14,000 women and girls who die each day from causes related to childbirth, 99% are in the developing world
- Progress is well behind the 2015 target

6. Combat HIV and AIDS, malaria and other diseases  
The aim is to halt and then begin to reverse the incidence of HIV and AIDS, malaria and other major diseases by 2015.

- The 2004 global report on AIDS concluded that there is almost no country where the spread of HIV/AIDS has been definitely stopped

7. Ensure environmental sustainability  
This goal embraces the general aim of sustainable development, while specifically seeking to halve the number of people without access to safe drinking water and sanitation, and to significantly improve the lives of the estimated 100 million slum dwellers.

- Over 2.4 billion people lack access to proper sanitation facilities
- 1 billion people lack access to drinkable water
- In sub-Saharan Africa progress falls far short of meeting the targets for this goal

8. Develop a global partnership for development

- This is to be achieved by establishing a fair and transparent world trade rules, debt relief and more and better quality aid

Developed countries to work in partnership with developing countries to provide the resources and structures needed to meet the MDGs targets including Overseas Development Assistance (ODA) of 0.7%.

## Notes

1. See Sen (1999). Also see Dréze and Sen (2013) for a discussion of economic development in India.
2. For a recent contribution to this topic, see Banerjee and Iyer. (2005).



3. For a critical discussion of neoclassical views of development, see Chang (2003).
4. See Dasgupta (1963), initially published in *Economic Weekly* 1954, and Robinson (1936). These papers in some ways anticipated Lewis's dual economy model.
5. See Bhaduri (2003).
6. In the words of Henry Ford "What is good for Ford (read Agriculture) is good for America (read less developed countries)."
7. For two views on this report, see Haroon Akram-Lodhi (2008) and also Byerlee (2009).
8. The ILO estimates the shares of employment in Agriculture using a "Trends Estimation Model." These data are provided in Appendix 1.
9. See Myrdal (1968).
10. Migration to the developed world also leads to significant remittances to the source country which has helped to increase capital accumulation in the agricultural sector as well as relaxing a foreign exchange constraint for the LDC. It has been argued that foreign remittances helped the Green Revolution prosper in Punjab, India.
11. See Bliss and Stern (1978) on efficiency wages, and Akerlof and Yellen (1986).
12. Source: <https://www.oxfam.org.au/what-we-do/aid-and-development/millennium-development-goals/what-are-the-millennium-development-goals/> (accessed 11-08-2015).

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**2**

## **Land Tenure, Agricultural Productivity and Taxation**

# 2.1

## Land Tenure and Indian Agricultural Productivity

P. N. Junankar

*The aim of this paper is to study the effects of land tenure on agricultural production. This is an econometric study of production functions for the Ferozepur district of Punjab using Farm Management Studies data for 1968/69 and 1969/70. After a brief review of the theoretical literature, production functions are estimated to test for differences between small and large farms and for the relative inefficiency of tenants (on an inferior production function) relative to owners. We get slightly ambiguous results on the farm size issue but we find that the more land leased in by a farmer, the less efficient he is.*

It has often been argued that the only long-term solution for Indian agriculture is a radical reorganisation of the institutional structure. There are two lines of thought about how we should proceed: the first one believes in a once-for-all change towards socialised agriculture, perhaps along the present Chinese pattern; the second argument is that one should break up the institutional power structure by ceilings on land ownership and the transfer of ownership rights to tenant cultivators.<sup>1</sup> The first suggestion is politically unfeasible unless there is a revolutionary change. To evaluate the impact on agricultural production under these circumstances would be difficult, since we would have to separate out temporary (short-run) and permanent (long-run) effects. One possible method would be to do a comparative study of Indian and Chinese agriculture, normalising for all but the institutional differences. This is clearly a difficult task. To evaluate the impact on agricultural production of land reforms is a relatively easier task. The impact of land ceilings can be assessed by looking at whether there is any significant difference between small and large farms, assuming that the components into which a large farm might be split up behave like small farms of that

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size. The impact on agricultural production of transferring ownership to the tenant cultivators can be studied by looking at the two types of farmers, 'owners' and 'tenants'. If small farms are more productive than large farms, then a land ceiling would increase production. Even if there were no significant difference in terms of production, a ceiling on landholding might be a way of breaking down the power of the landlord class, and might be desirable even in the absence of an expected improvement in agricultural production. It is in this context that the 'size of farm and productivity' issue is important. If we can show that owner-farmers are more productive than tenants, we might conclude that a land reform which gives 'land to the tiller' would increase production as well as lead to a break-up of the landowning monopoly. Such a land reform would also have long-run effects by influencing the savings and innovation behaviour of farmers as well as changing the incentive structure. These long-run effects would have to be studied in a different framework from that presented in this paper [Dorner, 1972].

The aim of this paper is to carry out an empirical investigation of the above issues. Using Farm Management Studies data for Punjab, we get slightly ambiguous results on the 'farm size and productivity' issue, but we find that tenants are less productive than owner-farmers. Section 1 outlines briefly the theoretical arguments put forward to explain the inverse relation between farm size and productivity, and the inefficiency of tenant farmers. Section 2 discusses the data sample. Section 3 tests these hypotheses, using disaggregated data from the Farm Management Studies, and then compares them briefly with previous work. Section 4 concludes the paper with some suggestions for further work in this field.

## I (A) Farm size and productivity

One of the striking results to come out from the Farm Management Studies data of the mid-50s was the inverse relationship between farm size and productivity per acre. It was observed that small farms, on average, employed more inputs per acre and as a result had a higher output per acre. These 'facts' were rationalised by Sen [1966, 1975], amongst others [Mazumdar, 1965], by arguing that small farmers were maximising output while large farms were run on capitalist lines and maximised profits. Assuming that labour on small farms had zero opportunity cost (i.e. there were no alternative employment possibilities and there was leisure satiation), then these farms would employ labour up to the point of zero marginal productivity (i.e. maximising output rather than profits). Large farms, however, would employ labour up to the point where the (positive) wage rate equalled the marginal product. Hence small farms would use more labour per hectare than large farms. In addition, inputs complementary to labour would also be used to a greater extent on small farms. Srinivasan [1973] argues that if farmers are maximising the expected utility of their income (and

if they are risk averse), then it is optimal for small farms to employ more inputs per hectare, even if they face the same labour market as the large (capitalist) farmer.

An alternative hypothesis, which would lead one to expect large farmers to be on a more efficient production function than small farmers, relies on differential access to information (and inputs) relating to the new high-yielding varieties technology. Thus, if small farmers have less formal education than big farmers for this or other reasons, they may not know about the green revolution technology or may not introduce the new technology as quickly as the large farmers. A more important reason to expect small farmers to be on an inferior production function is that they are unable to raise a sufficient amount of capital to buy the essential inputs, viz. irrigation (tube wells, pumps), fertilisers, tractors etc. As the credit market is imperfect, loans are usually available only with land as collateral or at extortionate rates from village money-lenders [Sen, 1975]. Thus, the lack of credit prevents the small farmer from introducing high-yielding varieties of wheat and keeps them on an inferior production function to farmers who have more land and can therefore raise more credit.

In the next section we propose to test these hypotheses by (i) regressing inputs per hectare on farm size, (ii) regressing output per hectare on farm size, (iii) estimating Cobb-Douglas production functions with a size dummy, and (iv) estimating separate Cobb-Douglas functions for 'small' and 'large' farms.

## (B) Tenancy

There are two main arguments against tenant farming. The *first* argues that *share-cropping* tenants would use fewer of the variable inputs than owners [Bardhan and Srinivasan, 1971; Adams and Rask, 1968]. This is sometimes called the 'tax-equivalent' approach and can be illustrated as follows:

Assuming maximising behaviour on the part of the share-cropping tenant, he would use OA units of the variable input (say, labour). If the farm was run by an owner (assuming the *same* production function), he would use OB units of the variable input if he is maximising profits. Thus, given land size, a tenant would have a lower labour-land ratio than an owner farmer. Thus, the output per hectare would be greater for an owner than for a tenant sharing output but not costs. This partial equilibrium result can be extended to the general equilibrium case under certain restrictive assumptions, e.g. that there are competitive conditions and that the landlord cannot require the tenant to provide specified amounts of inputs (on account of the high costs of enforcement) [Bardhan and Srinivasan, 1971; Cheung, 1969; Newbery, 1973; Koo, 1973; and Stiglitz, 1974].

A second line of argument against tenant farming maintains that even if tenant farmers use the *same* level of inputs, their output would be lower,

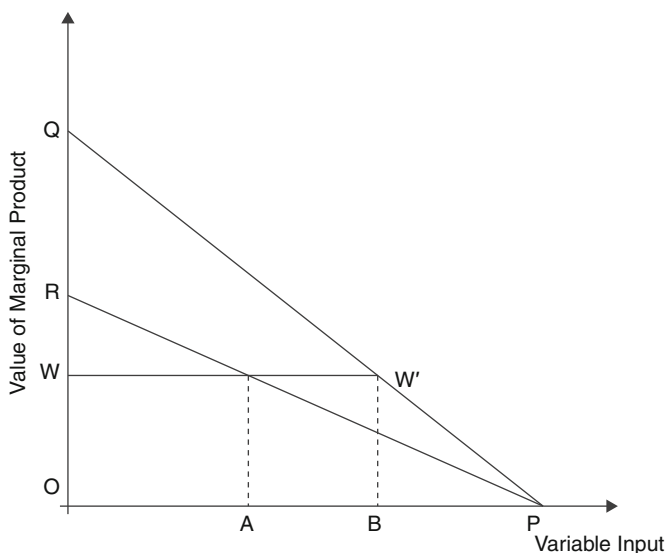


Figure 2.1.1 Diagram 1

$PQ$  is the value of the marginal product to the farm.

$PR$  is the value of the marginal product to the share cropping tenant.

$WW'$  is the (given) price of the variable input.

due, perhaps, to inadequate supervision, less innovative production, and so on. This argument relies on the blunted incentive amongst sharecropping and fixed rent tenants due to the tenant's uncertain security of tenure. A tenant subject to uncertainty of length of tenure *may* use the same *quantity* of inputs, but is likely to ignore important 'labour investments', such as improving drainage, irrigation, etc. We would expect the *structure* of investment (capital) goods to be different for tenants and owners. *A priori*, we can argue that a tenant who is uncertain as to his length of tenure would tend to invest in assets which are marketable (or can be easily removed to another farm), and/or in capital goods which have shorter gestation lags [Dorner, 1972: 113–126]. The result of this would be that a tenant would, in effect, be on an *inferior* production function. (The arguments about the difficulty of obtaining credit by a small farmer apply *pari passu* for a tenant.)

The procedure we followed to test whether the behaviour of tenants was different from that of owners was to estimate Cobb-Douglas production functions. We estimated these with a tenancy variable and then estimated separate functions for 'owners' and 'tenants'.

## II The data and list of variables

The data used in this study were collected for the Farm Management Studies by Punjab Agricultural University. The data are for 150 farms chosen on a multi-stage stratified random sample from the Ferozepur District of Punjab (1968/69 and 1969/70). Primary data were collected by the cost accounting method and secondary data from office records maintained by the revenue divisions and district headquarters.

### *Variables*

Output  $\equiv$  Value of main products (crops) Rs.

Farm Size A  $\equiv$  Area Owned + Leased in – Leased out (hectares) (often called 'operational holding')

Farm Size B  $\equiv$  Net Sown Area (hectares) i.e. that amount of Farm Size A that is cultivated.

Labour  $\equiv$  Family + Hired (hours)

Bullock labour  $\equiv$  Owned Bullock labour (hours)

Irrigated Area  $\equiv$  net irrigated area (hectares)

Tenancy Proxy  $\equiv \frac{\text{Area leased in}}{\text{Farm Size A}}$

Implements  $\equiv$  Total value of major implements + total value of minor implements (Rs)

Fertilisers + Manures  $\equiv$  Total *value* of fertilisers and manures (Rs)

Tractor Dummy =  $\begin{cases} 0 & \text{when Tractors} = 0 \\ 1 & \text{otherwise} \end{cases}$

Before we analyse the data, a few general characteristics of the sample should be noted. Punjab is a relatively rich state and for our sample the Mean Farm Size A (area owned + leased in – leased out) was 12.31 hectares in 1968/69 and 12.36 hectares in 1969/70, and Farm Size B (net sown area) was 11.17 hectares in 1968/69 and 11.71 hectares in 1969/70. The proportion of the land irrigated is also very high (total irrigated area/total net sown area was 94% in 1968/69). For our sample, self-cultivation was predominant and tenancy (total area leased in/total farm size A) was relatively low (10.8% in 1968/69 and 11.7% in 1969/70). Almost all the farmers who leased in land had some land they owned. Thus, there were no 'pure' tenants. Unfortunately, I did not have access to the breakdown of tenancy according to type of lease, e.g. share-cropping or fixed money (or kind) rent. According to data presented in the Farm Management Studies Report, the amount of land under self-cultivation for 1967/68 was 89.73%, cash rented 2.66%, fixed kind rented 0.51%, and 7.10% was share rented. For various reasons we would expect this data to underestimate the land leased in. Below we present a table which shows the major part of the land leased in was by farms larger than 10 hectares.



Table 2.1.1 Distribution of area leased in (%) by Farm Size A

|         | A≤5  | 5<A≤10 | 10<A≤15 | 15<A≤20 | A>20  | Total  |
|---------|------|--------|---------|---------|-------|--------|
| 1968/69 | 1.67 | 19.12  | 28.83   | 27.85   | 22.54 | 100.00 |
| 1969/70 | 3.70 | 30.02  | 14.46   | 34.05   | 17.77 | 100.00 |

Notes: 1. A is Farm Size A.

2. All figures quoted are  $\left( \frac{\text{Total Area leased in by Size Group}}{\text{Total Farm Size A}} \right) \%$ .

3. Due to rounding rows may not sum to 100.00.

The main crop for this region was wheat and almost all farms used hired labour (in addition to family labour) at peak seasons, e.g. harvesting. This was a period of fairly rapid change in this region. The new high yielding varieties of wheat ('Mexican Wheat') were being introduced, irrigation was being improved (tube wells and electric pumps), fertilisers (as opposed to manures) were being used, tractors were becoming more popular. As one would expect, the rich (large) farmers seem to have benefited most from these changes [Junankar, 1975]. Thus, we may expect large (owner) farmers to be on a superior production function compared to small (tenant) farmers and for this region we may expect to find results that contradict the earlier mid-fifties results. In the next section we report the tests.

### III Tests

#### (a) *Results on Farm Size and Productivity*

We proceeded by carrying out simple tests to see whether there was an inverse relation between farm size and productivity. For this purpose we regressed output per hectare (and output per man hour) on farm size and a tenancy proxy. We also regressed various inputs per hectare on farm size and a tenancy proxy. These regressions were run in linear form, and then with the dependent variable and the farm size logged. For the farm size we used net sown area and repeated the regressions with Farm Size A (land owner + leased in – leased out) instead. The results we obtained were broadly similar for the two alternative definitions of farm size and for the two years, and in Table 2.1.2 below we quote the results for the linear equation for 1968/69, using net sown area as farm size.

These regressions are almost certainly mis-specified, but we should treat these results as suggestive for further work. To make any sense of them, we have to assume that the error terms in the above equations satisfy the usual properties. As is to be expected, the explanatory power of these regressions is very low. In general, what the results suggest is that the amount of human and bullock labour per hectare declines with the net sown area (farm size) and implements per hectare increase with it. Output per hectare is quite

Table 2.1.2 Relationship between input/output per hectare and tenancy and farm size (1968/69)

| Dependent variable           | Constant            | Net Sown Area      | Tenancy Proxy       | $\bar{R}^2 \cdot 100$ | F                |
|------------------------------|---------------------|--------------------|---------------------|-----------------------|------------------|
| Output/Net Sown Area         | 1615.071<br>(15.03) | 5.944<br>(0.77)    | -339.692<br>(-1.18) | 0                     | 1.0 <sup>†</sup> |
| Output/Labour                | 1.903<br>(13.01)    | 0.072<br>(6.86)    | -1.104<br>(-2.82)   | 26.3                  | 27.6             |
| Labour/Net Sown Area         | 823.962<br>(18.51)  | -14.032<br>(-4.38) | 121.804<br>(1.02)   | 10.9                  | 10.2             |
| Bullocks/Net Sown Area       | 230.722<br>(19.05)  | -6.471<br>(-7.42)  | -0.416<br>(-0.01)   | 26.3                  | 27.6             |
| Irrigated Area/Net Sown Area | 0.975<br>(33.69)    | -0.002<br>(-0.81)  | -0.072<br>(-0.93)   | -0.3                  | 0.7 <sup>†</sup> |
| Implements/Net Sown Area     | 177.002<br>(2.45)   | 12.966<br>(2.49)   | -233.715<br>(-1.21) | 3.7                   | 3.9*             |

Notes: Sample size,  $n=150$ .

Parentheses contain  $t$ -statistics.

<sup>†</sup>Not significant at .05 level.

\*Significant at .05 level but not significant at .01 level.

unrelated to net sown area or to the tenancy proxy. The most striking result is that output per unit of labour increases with net sown area but *decreases* with the amount of land leased in. The relationship between the average product of labour and net sown area can be explained in terms of the complementarity of land and labour. But, since there is no noticeable relation between inputs per hectare and the amount of land leased in, the negative relation between the average product of labour and the tenancy proxy needs further investigation.<sup>3</sup>

Our next step to study the farm size and productivity issue was to estimate production functions. As discussed earlier, we wanted to test whether small and large farmers have *different* production functions. We hypothesised that

- (a) Small and large farms have identical production functions except for a multiplicative constant, i.e.

$$Y_S = A_S f(X)$$

$$Y_L = A_L f(X)$$

where  $Y_S$  is the output of small farms,  $Y_L$  the putput of large farms, and  $X$  is a vector of inputs,  $A_S$  and  $A_L$  are parameters assumed to be different, while the function  $f(\cdot)$  is identical for the two sets of farmers. Thus if  $A_L$  is greater than  $A_S$ , large farms are more efficient (productive) than small farms.

(b) Small and large farms have different production functions, i.e.

$$Y_S = F_S(X)$$

$$Y_L = F_L(X)$$

and large farms are most efficient (productive) if for *any*  $X$ ,  $F_L(\cdot)$  is greater than  $F_S(\cdot)$ .

(Note that hypothesis (a) is a special case of this hypothesis.)

We assumed the production functions were Cobb-Douglas (thus imposing a unitary elasticity of substitution) partly because of the ease of estimation and partly because it has been found to perform fairly well in previous studies. To test hypothesis (a) we estimated a function with a Size Dummy.

$$\ln Y = \ln A + \beta_1 \ln X_1 + \dots + \beta_n \ln X_n + \gamma \text{ Size Dum.} + u$$

To test hypothesis (b) we estimated *different* Cobb-Douglas production functions for small and large farms and then tested to see whether there was a significant difference between the two. These results are presented in the next subsection. Thus we estimated

$$\ln Y_S = \ln A_S + \beta_{1S} \ln X_{1S} + \dots + \beta_{nS} \ln X_{nS} + u_S$$

$$\ln Y_L = \ln A_L + \beta_{1L} \ln X_{1L} + \dots + \beta_{nL} \ln X_{nL} + u_L$$

Assuming that the farms faced uncertainty due purely to weather fluctuations, we could assume that the error term was independent of the regressors.<sup>4</sup> In addition, we assume that it is log-normally distributed. It has been shown [Zellner *et al.*, 1966] that if farmers maximise expected profits then we can use Ordinary Least Squares for estimation without getting inconsistent results. For the purposes of this paper I shall make all the necessary assumptions to use OLS estimation.<sup>5</sup>

With the logarithm of the value of crop production as the dependent variable we tried different combinations of independent variables.<sup>6</sup> Ideally we should use a value-added concept rather than gross value, but data limitations prevent this. In addition, this value of crop production variable assumes that there are not any significant differences in crop composition. Farm Size Dummies were introduced into these regressions using Farm Size A or Farm Size B (net sown area) and with either 5 or 10 hectares as the dividing point. In Table 2.1.3 below we present a selection of the results.

As we see from Table 2.1.3 the explanatory power of these regressions is pretty high for a cross-section study.<sup>7</sup> Two of the variables (Labour and Net Sown Area) are of the right sign, less than one, and significant. The variable

Table 2.1.3 Cobb-Douglas production functions: farm size effects

| Equation Number | Sample                   | Constant        | Labour          | Net Sown Area   | Bullock Labour  | Size A Dum (5)    | Size A Dum (10) | Tractor Dummy   | Fertilisers & Manures | $\bar{R}^2$ , 100 | F     | Sum of Squared Residuals |
|-----------------|--------------------------|-----------------|-----------------|-----------------|-----------------|-------------------|-----------------|-----------------|-----------------------|-------------------|-------|--------------------------|
| 1.              | 1968/69<br><i>n</i> =150 | 2.774<br>(5.83) | 0.290<br>(3.39) | 0.196<br>(2.62) | 0.026<br>(1.53) | 0.054<br>(0.59)   |                 | 0.219<br>(2.73) | 0.535<br>(7.55)       | 86.4              | 158.7 | 12.065                   |
| 2.              | 1968/69<br><i>n</i> =150 | 2.829<br>(5.67) | 0.292<br>(3.41) | 0.178<br>(2.00) | 0.026<br>(1.48) |                   | 0.001<br>(0.02) | 0.226<br>(2.81) | 0.532<br>(7.52)       | 86.4              | 158.2 | 12.094                   |
| 3.              | 1969/70<br><i>n</i> =149 | 2.970<br>(4.21) | 0.422<br>(4.47) | 0.301<br>(3.64) | 0.036<br>(1.01) | -0.097<br>(-0.91) |                 | 0.304<br>(3.00) | 0.314<br>(4.10)       | 78.8              | 92.8  | 19.392                   |
| 4.              | 1969/70<br><i>n</i> =149 | 2.726<br>(3.70) | 0.433<br>(4.56) | 0.333<br>(3.86) | 0.037<br>(1.03) |                   | 0.024<br>(0.25) | 0.300<br>(2.95) | 0.321<br>(4.15)       | 78.7              | 92.2  | 19.496                   |

- Notes: 1. Dependent variable is log (to the base e) output.  
2. All independent variables are logged (to the base e), except the Size Dummies and the Tractor Dummy.  
3. Size A Dum (5) = 0 when Farm Size A ≤ 5 hectares  
1 otherwise  
Size A Dum (10) = 0 when Farm Size A ≤ 10 hectares  
1 otherwise  
4. Tractor Dummy = 0 when Tractors = 0  
1 otherwise  
5. Parentheses contain *t*-values

Bullock Labour has the right sign but is not significantly different from zero at usual levels of significance. The tractor dummy has the right sign and is significant.<sup>8</sup> The coefficient on fertilisers and manures has the right sign and is very significant. It is interesting to note that the introduction of this variable decreases the magnitude of the coefficient on labour as well as its statistical significance. (The results without this variable are presented in the Appendix.) As our main interest in this sub-section is the size of farm issue, we now turn to that variable. What we did was to test whether there was a simple multiplicative effect (additive in logs). We fitted zero-one Size Dummies using Farm Size A and Farm Size B and since the results are essentially similar we have only presented the equations using Farm Size A. As we can see, the signs seem to fluctuate from one year to the other, but since they have such low *t*-values, very little weight can be attached to the signs. Thus these results suggest that there is *not* a significant difference between small and large farms, as long as we only test for a multiplicative difference. In the next sub-section, we suggest there may be a more subtle difference between small and large farms.

### (b) *Tenancy*

We now turn to our main area of investigation. We propose to study the effects of tenancy in a production function context. Let us postulate a production function

$$Y = Ae^{\gamma M} X_1^{\beta k} u \dots X_k^{\beta k} u$$

where  $Y$  is output,  $X_i$  are the inputs,  $u$  is the error term assumed to be independent of the  $X_i$  and log-normally distributed.  $M$  is our 'efficiency in management' index which we postulate is related to the proportion of land leased in (tenancy proxy).

$$M = \delta T \quad \delta < 0$$

i.e. as tenancy ( $T$ ) increases, management efficiency decreases. This can be represented diagrammatically as in Diagram 2.

Assuming only 'pure' cases where the cultivators are either entirely owners or entirely tenants, we are postulating a production function that is identical up to a multiplicative constant (or additive constant in logs). For mixed farmers (part owner and part tenant) the production function would lie in between the two extremes such that the more land leased in, the nearer they would be to the straight line labelled 'tenants'. If in addition tenants used less of inputs than owners, by imposing the same production function on both groups we could get biased estimates. This is represented in the diagram by the straight line joining AB, i.e. assuming no difference between owners and tenants [Mundlak, 1961].

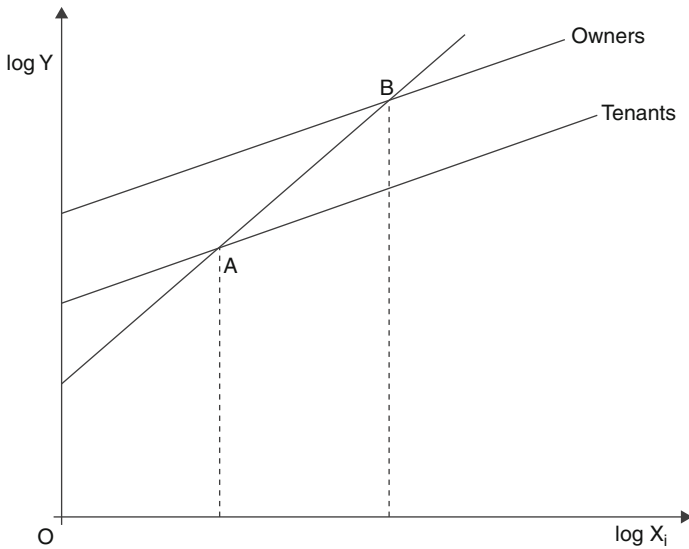


Figure 2.1.2 Diagram 2

To test the above hypothesis, we estimated a Cobb-Douglas production function with a proxy variable for tenancy. As most of the farmers who leased in land also owned some land (for our sample), we used the proportion of land leased in to Farm Size A as our index of tenancy. (An alternative procedure using a zero-one dummy for tenancy such that pure owners were distinguished from mixed cases of part tenant/part owner was tried in preliminary work. This gave similar results, but the nature of our sample led us to prefer the alternative used in this paper). The amount of land leased in was normalised by the Farm Size, since we postulated that the effect on production would depend on the *relative* importance of tenancy rather than on the absolute amount of land leased in. We estimated those equations for 1968/69, for 1969/70, and for the pooled data for both years. Again, the dependent variable was the value of crop production and log-linear equations were estimated by OLS. The results are presented below in Table 2.1.4.

The independent variables are the same as those used in the regressions in Table 2.1.3, except that we have now included another variable, Irrigated Area divided by Net Sown Area. The purpose of this variable is to take account of differential rates of irrigation as well as to make some allowance for multiple cropping, as we would expect multiple cropping to be directly related to the irrigation available. This variable would also be related to the introduction of new varieties of seeds and improved methods of production [Bardhan, 1973].

Table 2.1.4 Cobb-Douglas production functions: effects of tenancy

| Equation Number | Farm Size A              | Sample                     | Constant        | Labour          | Irrigated         |                      | Tenancy Proxy     | Tractor Dummy   | Fertilisers & Manure | $\bar{R}^2$ , 100 | F     | Sum of Squared Residuals |
|-----------------|--------------------------|----------------------------|-----------------|-----------------|-------------------|----------------------|-------------------|-----------------|----------------------|-------------------|-------|--------------------------|
|                 |                          |                            |                 |                 | Net Sown Area     | Area + Net Sown Area |                   |                 |                      |                   |       |                          |
| 1.              | Small $\leq 10$ hectares | 1968/69<br>$n=73$          | 2.889<br>(4.58) | 0.193<br>(1.67) | -0.055<br>(-0.45) |                      | 0.012<br>(0.39)   | 0.167<br>(1.05) | 0.734<br>(6.68)      | 77.9              | 43.2  | 5.260                    |
| 2.              | Large $> 10$ hectares    | 1968/69<br>$n=77$          | 1.751<br>(2.20) | 0.508<br>(3.97) | 0.399<br>(3.08)   |                      | 0.010<br>(0.44)   | 0.146<br>(1.50) | 0.350<br>(3.69)      | 79.0              | 48.7  | 5.380                    |
| 3.              | Both                     | 1968/69<br>$n=150$         | 2.710<br>(5.82) | 0.326<br>(3.76) | 0.183<br>(2.73)   |                      | 0.022<br>(1.30)   | 0.204<br>(2.58) | 0.512<br>(7.24)      | 86.7              | 162.5 | 11.819                   |
| 4.              | Small $\leq 10$ hectares | 1968/69<br>$n=73$          | 3.026<br>(5.17) | 0.202<br>(1.88) | 0.034<br>(0.27)   | 0.263<br>(2.05)      | 0.042<br>(0.19)   | 0.135<br>(0.89) | 0.690<br>(6.51)      | 79.1              | 46.5  | 4.956                    |
| 5.              | Large $> 10$ hectares    | 1968/69<br>$n=77$          | 2.294<br>(2.71) | 0.457<br>(3.54) | 0.466<br>(3.73)   | 0.276<br>(1.65)      | -0.311<br>(-2.11) | 0.133<br>(1.61) | 0.327<br>(3.56)      | 79.8              | 50.9  | 5.194                    |
| 6.              | Both                     | 1968/69<br>$n=150$         | 3.018<br>(6.46) | 0.324<br>(3.95) | 0.261<br>(3.78)   | 0.313<br>(3.08)      | -0.222<br>(-1.81) | 0.155<br>(2.24) | 0.470<br>(6.73)      | 87.4              | 172.5 | 11.215                   |
| 7.              | Small $\leq 10$ hectares | 1969/70<br>$n=76$          | 2.859<br>(2.83) | 0.356<br>(2.71) | 0.560<br>(3.37)   |                      | 0.186<br>(1.55)   | 0.300<br>(1.52) | 0.175<br>(1.61)      | 62.3              | 21.7  | 9.658                    |
| 8.              | Large $> 10$ hectares    | 1969/70<br>$n=73$          | 3.445<br>(2.97) | 0.318<br>(2.15) | 0.209<br>(2.19)   |                      | 0.012<br>(0.33)   | 0.322<br>(2.72) | 0.449<br>(4.08)      | 68.3              | 26.8  | 7.486                    |
| 9.              | Both                     | 1969/70<br>$n=149$         | 2.881<br>(4.20) | 0.434<br>(4.61) | 0.332<br>(4.21)   |                      | 0.034<br>(0.94)   | 0.296<br>(2.93) | 0.304<br>(3.86)      | 78.8              | 92.7  | 19.413                   |
| 10.             | Small $\leq 10$ hectares | 1969/70<br>$n=76$          | 3.221<br>(3.41) | 0.492<br>(3.91) | 0.619<br>(3.94)   | 0.340<br>(2.06)      | 0.037<br>(0.18)   | 0.117<br>(0.66) | 0.130<br>(1.17)      | 63.3              | 22.5  | 9.414                    |
| 11.             | Large $> 10$ hectares    | 1969/70<br>$n=73$          | 4.535<br>(4.18) | 0.163<br>(1.19) | 0.542<br>(4.40)   | 0.520<br>(3.79)      | -0.460<br>(-2.80) | 0.260<br>(3.02) | 0.386<br>(3.83)      | 73.9              | 34.9  | 6.161                    |
| 12.             | Both                     | 1969/70<br>$n=149$         | 3.583<br>(5.41) | 0.409<br>(4.72) | 0.494<br>(6.04)   | 0.426<br>(4.47)      | -0.216<br>(-1.65) | 0.190<br>(2.39) | 0.222<br>(2.92)      | 81.3              | 108.2 | 17.127                   |
| 13.             | Both (Pooled)            | 1968/69 & 69/70<br>$n=299$ | 2.460<br>(6.17) | 0.478<br>(7.64) | 0.263<br>(5.00)   |                      | 0.025<br>(1.45)   | 0.261<br>(4.06) | 0.332<br>(6.43)      | 81.9              | 226.2 | 33.927                   |
| 14.             | Both (Pooled)            | 1968/69 & 69/70<br>$n=299$ | 2.917<br>(7.44) | 0.465<br>(7.97) | 0.382<br>(6.99)   | 0.379<br>(5.37)      | -0.210<br>(-2.30) | 0.185<br>(3.41) | 0.274<br>(5.41)      | 83.4              | 251.2 | 31.100                   |

For the time being looking at Equations 3, 9, 13 and 6, 12, 14 of Table 2.1.4, we see that for a cross-section study the corrected coefficient of determination ( $\bar{R}^2$ ) is pretty high in each case. For 1968/69 (Equation 3) we see that all the coefficients are the right sign and that they are of plausible magnitudes (less than one). All the variables (except Bullock Labour) are significant at a 5% level using a one-tail test or at a 10% level using a two-tail test. Since Bullock Labour is not significant in Equation 3, it is dropped and replaced by the variable Irrigated Area divided by Net Sown Area (Equation 4). In this case all the variables are significant at the 5% level on a one-tail test, or at a 10% level on a two-tail test. What is interesting to note is that the tenancy proxy variable is negative and significant, thus suggesting that the more land leased in by the farmer the smaller is his output. When the same equations were estimated without fertilisers and manures, essentially the same results were obtained (although magnitudes of coefficients were substantially different), except that the variable tenancy proxy had much higher  $t$ -values (see Appendix). These equations were then estimated for 1969/70 (Equations 9 and 12). Comparing Equation 9 with Equation 3 we see that although the signs of coefficients remain the same, the  $t$ -values for Bullock Labour and the tenancy proxy fall, and so does the  $\bar{R}^2$ . In Equation 9, the tenancy proxy is no longer significantly different from zero. However, by replacing Bullock Labour by the Irrigation variable, we find that the tenancy proxy is still significant and negative. (Again, compare these results with the equations estimated without fertilisers and manures where the tenancy variable is always negative and significant). To test for structural stability, we estimated the same equations with the data pooled for 1968/69 and 1969/70 (Equations 13 and 14), and carried out an  $F$  test. The  $F$ -test showed that there was a significant difference (at the 1% level) between the results for 1968/69 and 1969/70, supporting the view that this was a period of change. Thus these results support our *a priori* view that tenants are inefficient relative to owners, i.e. they are on a *lower* production function.

To explore this issue further, we split our data sample into two subgroups: small farms (i.e. with Farm Size A less than or equal to 10 hectares) and large farms (Farm Size A greater than 10 hectares). This cut-off point was chosen because, as we can see from Table I, most of the land leased in was by farms larger than 10 hectares. The reason for splitting our sample and estimating separate functions was to see whether there was a difference other than a multiplicative shift. These separate estimates are presented in Table 2.1.4, Equations 1, 2, 4, 5, 7, 8, 10 and 11.

The splitting of the data sample provides us with some interesting results. The first thing to note is that the tenancy proxy is negative and significant (with fairly high  $t$ -values) for all the equations estimated for large (> 10 hectares) farms. As we saw earlier (Table I), most of the land leased in is leased large farms and thus the negative sign on the tenancy proxy provides more support to our hypothesis. Small farms did not lease in much land and for



this sample there is not a significant influence of tenancy. A second feature to note is that for the tractor dummy we get higher  $t$ -values for large farms than for small farms. In fact, for 1969/70 we find that the tractor dummy is very significant for large farms. This presumably reflects the growing importance of tractors for large farmers. As we saw earlier, there is a significant difference between the results for 1968/69 and 1969/70. Similarly, there are differences between the split-sample results for 1968/69 and 1969/70. For 1968/69 the Labour and Net Sown Area (Land) coefficients are bigger for the large farms, while the ranking is reversed for fertilisers and manures. It is curious to note that the Net Sown Area coefficient is not significantly different from zero for small farms, which is presumably due to the high correlation with fertilisers and manures ( $r = 0.7$ ). The results for 1969/70 do not have any 'typical' features. In a further attempt to analyse these results, we carried out  $F$ -tests to compare the results for small and large farms. The  $F$ -tests showed that there was a significant difference (at the 5% level) between small and large farms when we included Bullock Labour (Equations 1, 2, and 7, 8) but there was not a significant difference when we excluded Bullock Labour and included the irrigation variable (Equations 4, 5 and 10, 11). Even in the cases where small and large farms are significantly different, the vector of  $\beta$  coefficients for small farms does not dominate (nor is dominated by) the vector of  $\beta$  coefficients for large farms. Thus, there is no unambiguous ranking of the production functions of small and large farms. Hence we conclude from this that we cannot say whether small farms are more (or less) efficient than large farms. However, we find that, for large farms, the more the land leased in the less efficient they are (on a lower production function).

To summarise these results, we find that owners are more productive than tenants for large farms, but there is no significant difference for small farms. These results are in direct contrast to Chakravarty and Rudra, who state, 'It would thus seem that the generally held idea about tenant farms' economic performance being worse than that of owner farms might be valid when the comparison is confined to small-sized farms, but not so when medium or big farms are thought of'. [1973: 1242].

To study whether there were differences in the production functions of owners and tenants (other than a multiplicative one) we fitted Cobb-Douglas production functions to the two groups separately. But here we came to a problem arising from our sample data: there were very few 'pure' tenants and most of the farmers who leased in land also had some owned land. We proceeded by using two alternative arbitrary demarcation lines:

- (a) A farmer is a 'tenant' if he leases in 25% or more of his farm (Farm Size A), otherwise he is an 'owner'.
- (b) A farmer is a 'tenant' if he leases in 50% or more of his farm (Farm Size A), otherwise he is an 'owner'.

Using these arbitrary definitions, we fitted log-linear functions to the *pooled* data (1968/69 and 1969/70), as there would be very few observations if we estimated the equations separately for each year. These results are presented in Table 2.1.5.

Taking the first four equations (i.e. using the definition of a 'tenant'), we see that the coefficients on Net Sown area and the irrigation variable are not significantly different from zero for 'tenants', although they are significant for 'owners'. According to Bardhan and Srinivasan [1971] tenants would lease in lands until the marginal productivity fell to zero. Our results give some support to this hypothesis, but it should be noted that with a Cobb–Douglas production function the marginal product is always the same sign (or zero). This result should be treated cautiously as we are using pooled data (when our earlier results suggested that this would be a mis-specification). Bullock Labour is significant for 'tenants' but not for 'owners' and human labour is better defined (higher *t*-values) for 'owners' than for 'tenants'. Finally, we carried out an *F*-test to compare the set of estimated coefficients for owners and tenants. This shows that Equations 1 and 2 were significantly different (and so were Equations 3 and 4). Although the production functions of owners and tenants were significantly different, one set of coefficients does not dominate the other and hence these results cannot be used to show that owners are superior to tenants or vice versa.

The results for the other definition of owner (less than 50% of land leased in) were similar in some respects (Equations 5–8). However, in one case we got a *negative* and significant coefficient for net sown area for 'tenants'! When we tested for a difference between Equations 5 and 6 (and Equations 7 and 8) we could not reject the null hypothesis of no difference between 'owners' and 'tenants'. Given our earlier findings, we should like ideally, to cross-classify by farm size *and* tenancy, but our data is inadequate for this. We conclude from the results presented in Table 2.1.5 that our arbitrary classification into owners and tenants may be inadequate. Since our sample contains mixed cases of owners and tenants, we need a continuous variable according to the proportion of land leased in to farm size rather than a simple zero-one variable. Thus, the results presented above in Table 2.1.4 are more important for our purposes, given our sample data.

Let us summarise the results of this section. A significant inverse relation exists between human labour and bullock labour per hectare and farm size. The average product of labour is positively related to farm size and negatively related to tenancy. There is not a simple multiplicative difference between small and large farms, but a more subtle difference such that the importance of tenancy differs for the two groups. Specifically, we find that for large farms, output is inversely related to the proportion of land leased in.

Table 2.1.5 Cobb-Douglas production functions: tenants and owners

| Equation Number | Sample Size    | Constant        | Labour           | Irrigated         |                      | Tractor Dummy     | Fertilisers & Manures | $\bar{R}^2$ , 100 | F     | Sum of Squared Residuals |
|-----------------|----------------|-----------------|------------------|-------------------|----------------------|-------------------|-----------------------|-------------------|-------|--------------------------|
|                 |                |                 |                  | Net Sown Area     | Area + Net Sown Area |                   |                       |                   |       |                          |
| 1.              | Owner<br><25%  | 2.360<br>(5.31) | 0.493<br>(7.727) | 0.319<br>(5.56)   |                      | 0.021<br>(1.06)   | 0.218<br>(3.14)       | 83.2              | 236.0 | 27.036                   |
| 2.              | Tenant<br>≥25% | 2.757<br>(3.22) | 0.326<br>(2.14)  | -0.132<br>(-1.06) |                      | 0.060<br>(1.71)   | 0.567<br>(3.37)       | 77.6              | 41.9  | 5.204                    |
| 3.              | Owner<br><25%  | 2.915<br>(6.74) | 0.473<br>(7.61)  | 0.446<br>(7.56)   | 0.395<br>(5.39)      |                   | 0.151<br>(2.54)       | 84.9              | 269.7 | 24.156                   |
| 4.              | Tenant<br>≥25% | 2.971<br>(3.40) | 0.347<br>(2.26)  | -0.017<br>(-0.13) | 0.309<br>(1.22)      |                   | 0.365<br>(2.96)       | 77.0              | 40.6  | 5.340                    |
| 5.              | Owner<br><50%  | 2.532<br>(6.06) | 0.470<br>(7.33)  | 0.301<br>(5.52)   |                      | 0.029<br>(1.66)   | 0.250<br>(3.83)       | 82.2              | 256.4 | 31.445                   |
| 6.              | Tenant<br>≥50% | 1.363<br>(1.04) | 0.537<br>(1.87)  | -0.349<br>(-1.71) |                      | -0.030<br>(-0.24) | 0.313<br>(0.57)       | 82.3              | 20.5  | 1.447                    |
| 7.              | Owner<br><50%  | 3.072<br>(7.46) | 0.457<br>(7.65)  | 0.430<br>(7.60)   | 0.396<br>(5.49)      |                   | 0.175<br>(3.13)       | 83.9              | 287.5 | 28.585                   |
| 8.              | Tenant<br>≥50% | 1.572<br>(1.25) | 0.451<br>(1.60)  | -0.303<br>(-1.15) | 0.140<br>(0.29)      |                   | 0.414<br>(1.91)       | 82.3              | 20.6  | 1.444                    |

## IV Summary and Conclusions

Let us begin by summarising our findings. First, on the farm size and productivity issue we retain an agnostic view. On the tenancy issue we suggest that there is some evidence to suggest that owners are more productive than tenants. The output of a farm is negatively related to the proportion of land leased in. There are many reasons why we should treat the above results as suggestive and use them for further research rather than treat them as being conclusive. Firstly, if our assumptions about the error term are not satisfied, OLS estimates are inconsistent. A better way of tackling this problem is using the profit function approach, but the data leave much to be desired. We propose to do this in a subsequent paper. Secondly, our sample is from a relatively prosperous state where tenancy is not as important as in other states. We should really repeat the above work using data from the other states to see how robust our results are. Thirdly, our results on tenancy can be contested by arguing that leased-in land is of a consistently poorer quality than owned land. This is a difficult issue to sort out unless we had much more information on the rents paid and the type of tenure (share-cropping, fixed money rent, or fixed kind rent). This clearly needs further research. A related issue is that leased-in land is further away from the main holding and thus receives relatively less attention. I suspect that this last is less likely as an explanation than the former one.

To return to the policy issues raised in the introduction, we see that our investigation in general supports the case for the imposition of a land ceiling. This is based on two counts: firstly, that there is no significant difference in the production functions of small and large farms; secondly, that tenants are relatively less productive than owners. If a land ceiling is imposed (and enforced!) and land in excess of the ceiling redistributed to landless labour, to small owner cultivators, or to the existing tenants, we should expect an improvement. This improvement would be not only in an ethical (re-distributive) sense but it would also increase (or, at worst, not lead to a decrease in) production. Similarly, a policy that gave ownership rights to tenants (even if the owner's land did not exceed the ceiling) would increase aggregate agricultural production and improve the distribution of income and wealth.

In our discussion we assumed that the production behaviour of the recipients of the surplus land would be no different from existing small farmers. There may be temporary adverse effects if the land is redistributed to people other than existing tenants. This might be because the 'new' farmers take some time to get used to managing a farm. For this reason, such a land reform should be accompanied by carefully designed extension services. We have also assumed that when a landlord gives up land in excess of the ceiling, his production behaviour is no different from the existing small farmer. Again, there may be temporary adverse effects while the farmer adapts to a

Appendix

Table 2.1.A Cobb-Douglas production functions: effects of tenancy

| Equation Number | Farm Size A              | Sample Data     | Constant     | Labour        | Irrigated     |                | Tenancy Proxy  | Tractor Dummy | $\bar{R}^2$ , 100 | F       | Sum of Squared Residuals |
|-----------------|--------------------------|-----------------|--------------|---------------|---------------|----------------|----------------|---------------|-------------------|---------|--------------------------|
|                 |                          |                 |              |               | Net Sown Area | Bullock Labour |                |               |                   |         |                          |
| 1.              | Small $\leq$ 10 hectares | 1968/69 $n=73$  | 3.026 (3.74) | 0.609 (4.89)  | 0.305 (2.19)  | 0.067 (1.81)   | -0.160 (-0.55) | 0.152 (0.75)  | 63.44             | 25.988  | 8.818                    |
| 2.              | Large > 10 hectares      | 1968/69 $n=77$  | 1.332 (1.56) | 0.817 (7.74)  | 0.503 (3.66)  | -0.007 (-0.30) | -0.440 (-2.74) | 0.163 (1.55)  | 75.29             | 47.318  | 6.429                    |
| 3.              | Both                     | 1968/69 $n=150$ | 2.295 (4.26) | 0.726 (9.34)  | 0.377 (5.26)  | 0.016 (0.80)   | -0.370 (-2.54) | 0.248 (2.69)  | 81.91             | 135.926 | 16.151                   |
| 4.              | Small $\leq$ 10 hectares | 1968/69 $n=73$  | 2.960 (3.98) | 0.650 (6.15)  | 0.427 (3.04)  | 0.475 (3.01)   | -0.069 (-0.25) | 0.063 (0.33)  | 66.24             | 29.252  | 8.143                    |
| 5.              | Large > 10 hectares      | 1968/69 $n=77$  | 1.992 (2.19) | 0.726 (6.39)  | 0.549 (4.13)  | 0.335 (1.87)   | -0.409 (-2.62) | 0.188 (2.14)  | 76.42             | 50.251  | 6.137                    |
| 6.              | Both                     | 1968/69 $n=150$ | 2.812 (5.28) | 0.662 (8.91)  | 0.459 (6.42)  | 0.431 (3.76)   | -0.332 (-2.38) | 0.204 (2.60)  | 83.46             | 151.324 | 14.771                   |
| 7.              | Small $\leq$ 10 hectares | 1969/70 $n=76$  | 3.413 (3.56) | 0.391 (2.99)  | 0.660 (4.23)  | 0.197 (1.62)   | 0.122 (0.64)   | 0.295 (1.48)  | 61.48             | 24.943  | 10.020                   |
| 8.              | Large > 10 hectares      | 1969/70 $n=73$  | 4.314 (3.41) | 0.510 (3.27)  | 0.364 (3.76)  | 0.026 (0.67)   | -0.628 (-3.17) | 0.389 (3.00)  | 60.84             | 23.374  | 9.372                    |
| 9.              | Both                     | 1969/70 $n=149$ | 3.562 (5.12) | 0.541 (5.73)  | 0.481 (6.66)  | 0.043 (1.15)   | -0.235 (-1.67) | 0.339 (3.21)  | 76.73             | 98.615  | 21.453                   |
| 10.             | Small $\leq$ 10 hectares | 1969/70 $n=76$  | 3.608 (4.07) | 0.529 (4.32)  | 0.689 (4.74)  | 0.387 (2.41)   | -0.039 (-0.21) | 0.101 (0.57)  | 63.09             | 26.642  | 9.601                    |
| 11.             | Large > 10 hectares      | 1969/70 $n=73$  | 5.415 (4.66) | 0.309 (2.13)  | 0.732 (5.91)  | 0.611 (4.12)   | -0.596 (-3.37) | 0.285 (3.03)  | 68.54             | 32.365  | 7.531                    |
| 12.             | Both                     | 1969/70 $n=149$ | 4.167 (6.44) | 0.479 (5.60)  | 0.624 (8.83)  | 0.497 (5.25)   | -0.318 (-2.46) | 0.200 (2.46)  | 80.31             | 121.747 | 18.152                   |
| 13.             | Both (Pooled)            | 1968/69 $n=299$ | 2.733 (6.46) | 0.661 (11.11) | 0.415 (8.28)  | 0.026 (1.43)   | -0.273 (-2.72) | 0.290 (4.24)  | 79.44             | 231.297 | 38.733                   |
| 14.             | Both (Pooled)            | 1968/69 $n=299$ | 3.238 (7.98) | 0.602 (10.94) | 0.527 (10.56) | 0.462 (6.40)   | -0.302 (-3.22) | 0.200 (3.51)  | 81.84             | 269.522 | 34.220                   |

new role where he may have to take a more active role in the management of the farm. We have not discussed the long-run effects of this policy and its effects on saving and investment. This would be the subject for another paper. It is important to note that, at least in the Indian context, the unit of ownership may be large but the unit of cultivation is often small. Therefore, in many cases the imposition of a ceiling and the transfer of ownership rights to the tenant would not lead to a change in the unit of cultivation, and would not have any adverse short-run consequences. However, the security of tenure achieved by the tenants is likely to have beneficial short- and long-term consequences. Our study is trying to predict *ex ante* what are the likely effects of a land reform using cross-section data. The actual *ex post* effects may differ if there are several other changes that take place concurrently. To conclude, our study supports the case for the imposition of a land ceiling and the transfer of ownership rights to tenant farmers.

## Notes

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1. Both sets of arguments can be found in Lehmann [1974]. See especially the papers by Bell, Byres and Lipton.
2. X-inefficiency [*Leibenstein, 1966*]. It is a common feature of Indian agriculture that tenants are moved around from time to time to avoid giving them any proprietary rights.
3. Similar results were obtained by logging the dependent variable and farm size. Similar results were also obtained using data for 1969/70.
4. I have some qualms about using this as a justification. The labour input would, in fact, depend on the weather, e.g. the amount of crop that has to be harvested depends on the weather, and hence affects the labour input.
5. In a subsequent paper I shall use the profit function approach [*Lau and Yotopoulos, 1971*].
6. Note that all logarithms are to the base *e*. Preliminary trials using the log of the value of crop production normalised by farm size (to eliminate possible heteroscedasticity) gave essentially the same results. The number of fragments and Zone dummies were tried but dropped, as they were insignificant and did not affect the other estimates.
7. There was incomplete data for 1969/70 for one of the farms and it was deleted from the sample.
8. As many farms did not own tractors, the variable could not be introduced in a Cobb–Douglas production function in the usual fashion. We therefore used a zero-one tractor dummy.

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## 2.2

# Land Ceilings as a Tax on Agriculture: A Note

P. N. Junankar

*In this note I have tried to show that land ceilings are conceptually equivalent to a wealth tax on agriculture.*

*The case for ceilings on equity grounds is very strong and that on efficiency grounds is also fairly strong.*

*Thus if we treat ceilings as 'just another tax' some of the opposition to it may weaken.*

The current discussion on land ceilings has concentrated on the distributional (equity) aspects of the measure. In this paper I would like to discuss the implications of ceilings on agricultural land in a broader context. I will look at both the equity and efficiency aspects of the imposition of land ceilings. Although I am aware of gross simplification, I shall assume that any measures passed by the Government are implemented effectively. It is well known that implementation of land reforms requires efficient administration and legislation that is retroactive. In the next section I will suggest that legislation on land ceilings is analogous to a form of (wealth) taxation and can therefore be studied in that context. This is, apparently, the first time that the subject is being looked at in a public finance context.

### I Ceilings and Taxation

Agriculture is in a favourable position *vis-a-vis* industry since it is not subject to any direct taxes. Assume that (a) all land is homogeneous and farmers face competitive conditions so that input and output prices are given, (b) there are non-increasing returns, (c) there is a positive discount rate and (d) there is certainty. Then there would be a one-to-one correspondence between 'permanent income' (the present value of the future stream of

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income) and the size of the farm. Now assuming no compensation, we can construe ceilings as a tax on permanent income when the tax rate is zero before some critical value and one after it. Since most of the existing suggestions include compensation as one of the features it implies that the tax rate after the critical value is greater than zero and less than one if the compensation paid is partial. It is feasible to work out a system of progressive taxation such that the amount of compensation paid decreases at the margin with the excess of the acreage over the ceiling.

## II Effects of the Tax

In this section I will look at the effects of a land ceiling on (a) equity and (b) efficiency.

(a) *Equity*: There are three aspects to keep in mind. Firstly, equity within agriculture; secondly, equity, between agriculture and industry (remembering that agricultural income is not taxed otherwise); and thirdly, equity on an individual basis. It should be noted that since income from non-agricultural sources is taxed we can compute, given our assumptions, the wealth tax equivalent. Agricultural income is not taxed which is *one* source of inequity. In the Table below I list the likely effects of the imposition of a land ceiling, ignoring the sources of revenue used for compensation purposes. Once we worry about where the finances for compensation come from we are unable to say anything unambiguously.

Thus we can say that, if we ignore the sources of finance for compensation payments, a land ceiling would lead to a more equitable distribution (except in case 2 when there is no change). This seems to have been the main justification for land ceilings. I will now turn to the aspect of efficiency which has not got as much attention in the literature.

(b) *Efficiency*: The effects of a ceiling (tax) on efficiency will be considered under two heads:

- (i) Static/short-run
- (ii) Dynamic/long-run

The static case is easy to deal with. Given our assumptions of homogeneity, certainty and no technical change a ceiling (tax) is a once for all event and therefore has no disincentive effects. As long as changes in the ceiling (tax) or the compensation rates are unforeseen there would be no problems. As it is a once for all tax there would be no shift of resources from agriculture to industry. People would not move from agriculture to industry because of our assumption of effective retroactive legislation. The compensation payments received would move to industry, but they *may* have been collected in industry and hence there would be no net changes. If the compensation payments were collected in agriculture there would have been a once for all shift from

Table 2.2.1 Likely Effects of Imposition of Land Ceiling

|                                                              | Within<br>Agriculture | Between<br>Agriculture<br>and Industry | Individual<br>Basis |
|--------------------------------------------------------------|-----------------------|----------------------------------------|---------------------|
| (1)                                                          | (2)                   | (3)                                    | (4)                 |
| (1) No compensation (with<br>or without redistribution)      | X                     | X                                      | X                   |
| (2) Compensation (full)<br>without redistribution            | —                     | —                                      | —                   |
| (3) Compensation (full) with<br>redistribution               | X                     | X                                      | X                   |
| (4) Compensation (partial) with<br>or without redistribution | X                     | X                                      | X                   |

Notes: x indicates an 'improvement', i.e., treatment is more equitable. — indicates 'no change'. 'Redistribution' refers to the land collected in excess of the ceilings which it is assumed would be given to small land owners, tenants or landless labour. Industry refers to all non-agricultural activities.

agriculture to industry. In addition, there is fairly good evidence for an inverse relation between farm size and productivity. Thus a land ceiling combined with redistribution would lead to an overall improvement in agricultural productivity. Thus on static grounds the case for a ceiling (tax) is very strong.

The dynamic/long run case is more difficult to analyse. It is impossible to say *a priori* what the effects on savings, investment and innovations would be because of changes in distribution within agriculture. What can be said is that since agriculture is not taxed at all now and if the Government wished to tax it either by an agricultural income tax or a ceiling (wealth tax) both of these methods would have various repercussions. A wealth tax is likely to have fewer adverse incentive effects than an income tax.

Thus land ceilings have no disincentive effects in the static case (unlike an agricultural income tax) while the long-run case is indeterminate. In fact we have reason to believe that ceilings would improve agricultural productivity.

### III Conclusions

In this note I have analysed the subject of land ceilings at a fairly high level of abstraction to derive some firm conclusions. I do not think those conclusions would be contradicted for a more 'realistic' model. Since there is a well recognised body of literature on the theory of public finance, it seems to me that we can apply its principles to the subject in hand.

In this note I have tried to show that land ceilings are conceptually equivalent to a wealth tax on agriculture. As we saw earlier, the case for ceilings on equity grounds is very strong and that on efficiency grounds is also fairly strong. Thus if we treat ceilings as 'just another tax' some of the opposition to it may weaken.

## 2.3

### Review of *Palanpur: The Economy of an Indian Village*

P. N. Junankar

The book under review is a major study of behaviour in an Indian village, displaying an interesting combination of rigorous (neo-classical) economic theory and applied econometrics. At one time agricultural economics was a poor second cousin: it was even referred to as 'cow-dung economics' by the economics intelligentsia. Now, however, agricultural economics seems to have captured the imagination of leading mathematical economists (and that is the top of the hierarchy) like Stiglitz, Mirrlees, Bliss and Stern. No armchair theorists, Bliss and Stern have descended into the dust and din of an Indian village and collected enormous amounts of data with which to test theories of the allocation of factors of production. Moreover, this is not the work of 'mindless maximisers' from Chicago: it is a subtle analysis of economic behaviour using neo-classical tools. The authors' main concerns were whether farmers' decisions on inputs and outputs could be explained by an optimising model (whether farmers were 'rational' profit or utility maximising agents) and whether share-cropping tenancy was inefficient.

Bliss and Stern have described and studied one village in Uttar Pradesh (UP) near Delhi. The village was chosen because its main crop was wheat (which has been affected by the Green Revolution), because it was near Delhi (and the Indian Statistical Institute at which the authors were visiting Fellows) and because tenancy was common. They are quite explicit in stating that they were *not* looking for a village representative of UP and that they are not 'proposing generalisations for village India' (p. 235). However, they 'think that it [their study] is usefully suggestive' and, more controversially, that 'the intensive study of one village is an important testing ground for theories of rural development' (p. 235). If the village chosen

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is not representative (as they agree it is not) then we cannot *test* theories of rural development; all that an intensive village study can do is provide hypotheses and insights into rural development which need to be developed into models to be tested on a *representative* sample of villages. (The authors are aware that the village is not typical: it has less inequality of land ownership than UP in general and it has a higher than average amount of irrigated land.)

Another problem with this 'anthropological' approach to economics is that there is a danger (just as in anthropology) of the behaviour of the observed being affected by the existence of the observer(s). It is not impossible that the farmers in Palanpur changed their behaviour because of the penetrating questions being raised and being made to think of alternatives which may never have occurred to them. Similarly, because they were being observed, the farmers may have altered their behaviour. However, evidence reported by the authors about risk-averseness suggests that this influence is likely, at least in the short run, to be small.<sup>1</sup>

After a cursory acknowledgement of earlier work by Schultz, Myrdal, Hirschman and Bhaduri, the authors move to a more detailed analysis of neo-classical approaches to the study of farm size and productivity and of the efficiency (or inefficiency) of share-cropping tenancy. They provide an excellent review of the theoretical literature on tenancy which begins with Adam Smith on *métayage*, goes on to Marshall and Cheung, and concludes with the uncertainty analysis of Stiglitz and Newbery. In passing, they also review the literature on the efficiency-wage hypothesis, although they argue that it is unimportant for India. Their approach is neo-classical with risk-averse farmers maximising expected utility. However, unlike Chicago economists, they acknowledge the existence of 'imperfections': the labour market, the bullock-services market, the land market and the credit market are recognised to be imperfect. But this does not prevent them (except when analysing tenancy, see below) from analysing farmers as if they were facing parametric prices without rationing. Although the authors discuss the importance of caste in Palanpur (p. 12), they do not consider the role of *class* in rural development. In general, they deny the importance of Bhaduri's seminal paper on 'semi-feudalism' and the problem of 'interlinking' of factor markets (see pp. 122–3). All the same, it is hard to see what remains of traditional neo-classical economics when most of the key markets are acknowledged to be imperfect and non-price relations affect behaviour.<sup>2</sup>

The major contribution of the book is in proposing a new theory of tenancy which exploits the 'imperfections' in the bullock services market and in the labour market. Adapting the capital stock adjustment principle (which has been quite successful in investment theory) the authors postulate a 'desired cultivated area' (DCA) which is determined by family size and by the value of bullocks owned. Assuming increasing marginal costs of adjustment, the amount of land leased in is a function of DCA and land owned. This explanation depends crucially on the absence of a market for

bullock *services*. However, there is a market for bullocks which would be an alternative way of reaching DCA. They do not really provide an explanation of why this does not occur. In fact, they find that for Palanpur this model works better for those leasing out land than for those leasing in. This suggests that the better-off farmers who could afford (or obtain credit) to buy bullocks prefer to lease out land. Why?

Bliss and Stern have provided an interesting account of rural markets in Palanpur. They remind us that there are laws prohibiting tenancy in UP which are clearly being evaded by the use of share-cropping tenants who can be made to appear as wage-labour. The book provides us with some insights into personal and caste rivalries. They point out 'imperfections' in the labour market due to caste: *Thakurs* do not provide wage-labour as it is demeaning. Imperfections in the credit market are reflected by the differential access to credit: it is easier (and cheaper) for higher caste farmers to obtain credit. There is much detail about the type of share-cropping contract and the extent to which landlords involve themselves in supervision and cost-sharing. However, a lot of these 'institutional' details disappear in the econometric work.

The econometric work consists of three main parts: an analysis of tenancy using a capital-stock adjustment model (see above), estimation of production functions for value of annual output of *all* crops and estimation of production functions for the *rabi* season wheat crop.

In some preliminary analyses (Chapter 5) the authors find that the yield on tenanted land is significantly greater than on non-tenanted land where a farmer is cultivating wheat on *both* kinds of land. However, they cannot explain this in terms of differences in, for example, fertilisers and ascribe the result to chance (p. 136). They then go on to estimate their (linear) model which explains net leased in land (NLIR) in terms of value of bullocks, adult males in family and land owned. They find all the variables significant with land owned being very significant ( $t = 14.6$ ). However, they find other variables like caste dummies insignificant.

Curiously, they then try to 'explain' the large residuals for particular farmers by *ad hoc* reasons. Although their sample consists of three distinct groups (30 non-transactors, 37 who lease out and 40 who lease in), they do not use dummy variables to test for differences in the parameter vectors. Instead, they split the sample into those who lease in and lease out (excluding the non-transactors) and find results for the latter group are 'better'. In other words, it is leasing out that carries the burden of adjustment.

Overall, these results are suggestive but need to be investigated further with formal tests of hypotheses about similarities of different groups of households. In addition, they need to be more careful to avoid econometric problems (simultaneous equations) involved in estimating an equation where the right-hand side variables are endogenous (decision) variables (e.g. value of bullocks which can be bought or sold).

In Chapter 6 the authors estimate 'production functions' which, in fact, embody technological *and behavioural* relationships. They fit linear and log-linear equations to explain the gross value of annual output in terms of stocks of labour, bullocks, pump sets and land. Caste and tenancy dummies are thrown in without much success. Overall, these results seem to explain annual output more-or-less entirely in terms of cultivated area. These results, in effect, deny the importance of 'institutional' variables like caste and tenancy which their own 'informal' evidence suggests are important. This is an area which needs further investigation. Again, however, econometric problems of including endogenous variables on the right hand side are ignored.<sup>3</sup>

Chapter 7 provides an interesting discussion of new varieties of wheat and includes a wealth of institutional detail which somehow gets lost in subsequent analysis. The authors discuss how they chose a random sample of plots for an intensive analysis. However, they blandly admit that they included one plot solely because the farmer requested it! (It would be interesting to see how the results would alter if this observation were excluded from the regression analysis.)

Chapter 8 estimates linear and log-linear production functions for wheat per acre (assuming constant returns to scale) in terms of 'tasks' like number of ploughings, number of irrigations, whether or not the plot was weeded, etc. This is a novel procedure for estimation of production functions which the authors could follow with their detailed study. They were even able to allow for the *timing* of inputs by using discrete variables. When they attempt to fit log linear functions, they find that, for eight plots, no fertiliser was applied. Since the logarithm of zero is undefined, they follow a peculiar procedure and add an arbitrary value which is chosen to maximise the  $R^2$ ! They do, however, rely mainly on the results from the linear production function so that the peculiarities of the log linear estimation are not very important. Their results for the linear case are interesting, and they find that caste is significant in explaining yield, that a bigger farmer has a lower yield but tenancy is insignificant. They compare the value of marginal products with prices and find for fertilisers that the ratio is over 3! They explain this as being due to highly risk-averse farmers. Again, however, they seem to ignore the possibility that farmers can affect the degree of uncertainty by the choice of inputs. This is an additional reason to worry about simultaneity bias when the right-hand side variables are endogenous.

The authors make several interesting comments towards the end of Chapter 8 which suggest that farmers are not technically efficient. They also go so far as to say that '[W]e are unable to confirm that neo-classical economics is alive and well and residing in Palanpur, at least in its simplest form' (p. 291). They even agree that 'farmers were not doing the best they could do given their resources' (p. 293). In other words, they are denying the relevance of an optimising model! If farmers are not technically efficient

and if they are not optimising, then fitting production functions to data on outputs and inputs is not meaningful. If they are optimising but not technically efficient, we could fit 'frontier production functions'.<sup>4</sup> But if farmers are not optimising, then life is very difficult for neo-classical economics. As Bliss and Stern say, 'one should not, and we did not, expect the world to be that simple' (p. 293).

After the discussion in Chapter 8, the penultimate chapter of 'Reflections on Economic Theory' comes as an anticlimax. Here Bliss and Stern suggest that farmers are aware of the consequences of changing input levels, that a supply and demand model of the Palanpur labour market 'is not obviously inadequate as a description' (p. 300) and that 'a maximisation model, *provided one selects an appropriate objective*, can be successful in explaining the farmers' behaviour' (p. 304, emphasis added). This is a long way from 'farmers were not doing the best they could do given their resources' or, again, from the finding that in not using inputs to reduce risk, 'households are simply not acting rationally' (p. 310).

It is normal in reviewing a book to point out its shortcomings and to tend to ignore its achievements. I should like to stress the importance of this book in attempting to tackle several interesting questions not simply by armchair theorising but on the basis of careful fieldwork. If nothing else, we learn from this approach that there are still a lot of unanswered questions. In my review I have criticised the book's neo-classical approach to the problems of agriculture in underdeveloped countries, but it remains an important book which deserves to be read by all development economists and especially those concerned with the Indian economy.

## Notes

1. Bliss and Stern have now started on a re-survey of Palanpur and we may find changes due to the farmers being observed.
2. Modern neo-classical economics attempts to allow for 'imperfections' but does not allow for political and economic power to be wielded by a particular class.
3. To avoid simultaneity problems some people estimate cost or profit functions [Lau and Yotopoulos, 1971]. Also see Junankar [1982].
4. See Førsund *et al.* [1980] and the remaining articles in that symposium.

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# 2.4

## Agricultural Taxation in Less Developed Countries: Effects of a Tax on Inefficiency

*M. Chatterji and P. N. Junankar*

The paper explores the effects of imposing an agricultural tax based on inefficiency (the deviation of actual output from potential output). The analysis is carried out in the context of an abstract partial equilibrium model where a farmer has two sources of income: agricultural production and 'usury income'. We derive three propositions on the basis of utility maximisation: (1) wealthier farmers lend a higher proportion of their wealth and use a lower proportion for productive activities; (ii) an increase in the inefficiency tax rate reduces money lending and increases the proportion of wealth productivity used; and (iii) an increase in the inefficiency tax rate increases output. A final section discusses the limitations of the analysis with suggestions for further research.

### 1 Introduction

One of the major problems facing less developed countries (LDCs) is an inadequate level of agricultural production. Several policies have been suggested as means to stimulating agricultural production: these include provision of irrigation and new technology (high yielding varieties of seeds), subsidised credit for purchase of inputs, land reforms and institutional change. Another possible method which is complementary to the others is to use the tax system in such a way as to provide positive incentives to increase agricultural output.

There are basically two ways of taxing agriculture: (i) an agricultural income tax and (ii) a wealth tax assessed on ownership or operation of land. A progressive agricultural income tax would be equitable but *may*

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have disincentive effects on agricultural production. In general, there is an income and substitution effect which operate in opposite directions. In effect, the tax system penalises the more enterprising farmers: there is a conflict between equity and productivity. A major problem with an agricultural income tax is in assessing 'income'. Given gross income from production what 'costs' are to be deducted? Firstly, there is a problem of whether to deduct 'implicit' costs of production, for example, family labour. If we decide to deduct implicit costs there is a problem of how to assess them. Secondly, there is a problem of separating current and capital costs. Is labour expended on building *bunds* or canals a capital or current cost? Even in the U.S.A. agricultural income taxes on plantations apparently have a very low yield as accounts are 'dressed up' to reveal losses!

A tax on wealth (in terms of say land-ownership) may affect savings and investment decisions but usually has a smaller impact on the marginal decisions affecting production or productivity. A variant of a wealth tax is that proposed by the Raj Committee on Agricultural Taxation (1972). They proposed an Agricultural Holdings Tax (AHT) which was based on the *potential* production of an 'operational holding' (area owned *plus* area leased in *minus* area leased out). Potential production was defined as that we could 'reasonably expect to be achieved with the use of the existing practices and techniques prevalent in the area, *not* what can be attained by adopting improved practices and techniques'. (Raj (1973)). Thus the taxes paid in any one year would be independent of the actual production (or income) in that year: the Raj Committee argued that this would provide an incentive to farmers to produce more to decrease the *relative* tax burden. 'This approach has the additional advantage that, by relating the tax to certain norms of productivity, it offers some built-in incentives to achieve higher levels of productivity, since the gains so secured by the producer will not be subjected to additional tax at the margin as in the case of the prevailing systems of taxation of income'. (Raj (1973)). However, a simple utility maximising model with taxes independent of output would leave all the marginal conditions unaffected.<sup>1</sup> Of course it is possible to formulate a model where the farmer's objective is to minimise the relative tax burden which would have the desired effect of increasing production. However, this is an arbitrary assumption (more arbitrary than usual) to make about farmer behaviour.

What is of some interest, therefore, is whether the production generating incentives of the Agricultural Holdings Tax carry over if, instead, we assume that farmers' objectives are of the more conventional type. If so, the potential usefulness of such a tax is surely enhanced.

In this paper we explore such a possibility. We examine the effects of a tax very similar to AHT but assume very conventional objectives on the part of farmers. We consider the effects on agricultural production of a tax on 'inefficiency', but we ignore the equity aspects of such a tax. The exercise is conducted within a very simply partial equilibrium framework which has many

limitations. However, it is consistent with a number of features commonly found in LDCs. For example, cross section studies from various countries usually find an inverse relation between productivity and farm size.<sup>2</sup> Our model is consistent with this finding. In our model larger and hence presumably wealthier farmers divert a higher proportion of their wealth to 'unproductive' activities like money-lending.<sup>3</sup> An interesting by-product of our model is that money lending activities are reduced. As money lending activities are sometimes considered to act as an institutional constraint on technological change, the suggested tax would ease that constraint. For other social reasons too, reduced money lending activities may be regarded as beneficial. Money lending activities provide political and social power over the poor and landless peasants and hence its restriction may be considered as a reasonable objective.

The plan of the paper is as follows. In Section 2 we discuss the tax on inefficiency which is a variant of AHT; in Section 3 we present the model; Section 4 notes some qualifications and discusses the results. The final section concludes.

## 2 A tax on 'inefficiency'

In this section we discuss the 'inefficiency tax' after a brief discussion in the context of agricultural production in LDCs. This tax combines some issues raised by Bhaduri (1973) and Nair (1979). In an important though controversial paper, Bhaduri (1973) argued that money-lending landlords would restrict technical change because their gain from share-cropping rent may be outweighed by the loss from money-lending (usury) income. Thus if we could somehow curtail money lending it would provide a spur to agricultural development. In an interesting book, *In Defence of the Irrational Peasant*, Kusum Nair (1979) discusses various social and institutional reasons which prevent farmers from producing up to their potential (maximum) output. She contrasts farmers who are more progressive in farming methods with those who are inefficient (produce *less* than potential output). Two farmers with equal land holdings of comparable quality would pay the same amount of taxes under the AHT system. It would be preferable to tax farmers such that the less efficient farmer is taxed more so that he is encouraged to be more efficient. (Note, we are using more efficient to mean being nearer the maximum or potential output. Efficient is *not* being used in a Pareto sense.) Following Kusum Nair we propose and formalise a tax on 'inefficiency' and study the effects of such a tax on agricultural production and money lending. As a by-product we can show that the *proportion* of money lent increases with 'wealth', i.e. the wealthier farmer is more inefficient as he is more involved in money lending rather than agricultural production. We (unashamedly) make the normative assumption that the Government's objective is to maximise agricultural production and is uninterested in the farmer's

leisure choices. This, in most LDCs, is not an unrealistic objective since it is often assumed that surplus labour exists in the agricultural sector. However, we do not want to get involved in that debate in this paper!

We assume that farmers have two sources of income: (i) from agricultural production and (ii) from money lending. Farmers have an initial endowment of wealth/'money' (which we can assume is proportional to, or some simple function of, land owned) which they can *either* lend to obtain an 'usury income' *or* they can purchase inputs which we call (under an all-embracing name) 'fertilisers'.<sup>4</sup> If they buy 'fertilisers' they increase their agricultural production but have a smaller 'usury income': there is a trade-off. The Government taxes the agricultural sector (see below) *but cannot tax income from money lending*. (This is an important assumption, but a realistic one!) We assume that all borrowing is for 'unproductive consumption' (e.g. lavish weddings, expenditures on religious festivals) by a group that it not modelled by us.

Assume that we have a homogeneous output ('wheat' or 'rice' or Ricardo's 'corn') with a constant price normalised to be unity by a suitable choice of units. In effect all variables, except labour services, are measured in terms of this single output. Let us now make the discussion more specific by introducing some notation:

- (i)  $C$ : the farmer's consumption of agricultural output;
- (ii)  $Y$ : agricultural output;
- (iii)  $L$ : the farmer's labour input and hence  $(1 - L)$  the farmer's leisure;
- (iv)  $F$ : quantity of 'fertiliser' purchased. Its price is assumed constant and set to unity by an appropriate choice of units;
- (v)  $M$ : the farmer's endowment of wealth measured in terms of agricultural output;
- (vi)  $\lambda$ : the *proportion* of the farmer's wealth lent to peasants in the non-farming sub-sector of the agricultural sector. Hence  $(1 - \lambda)$  is the proportion spent on fertilisers;
- (vii)  $r$ : the rate of interest on such 'money-lending' activities;
- (viii)  $T$ : taxes paid in terms of agricultural output;
- (xi)  $t, \alpha$ : the proportional tax rates on agricultural output,  $Y$ , and on inefficiency',  $(\bar{Y} - Y)$ , respectively; and
- (x)  $\bar{Y}$ : maximum output the farmer can produce given his initial land-holding and wealth.

We assume a production function

$$Y = f(L, F) \quad (1)$$

Since we are assuming that the amount of land held is given and *constant* we are subsuming it in the function ' $f$ '. We assume that the marginal products

are positive and diminishing. In addition, we assume that the marginal product of labour falls to zero after some critical level of labour,  $\bar{L}$ .

Our proposed tax function consists of two parts: a tax on gross agricultural output *plus* a tax on 'inefficiency'. Taxes are given by

$$T = tY + \alpha(\bar{Y} - Y) \quad (3)$$

$$0 < t, \alpha < 1 \text{ and } t > \alpha$$

For the sake of simplicity we are assuming the tax on agricultural output is a *proportional* tax. It would be easy to allow for a progressive tax by introducing an exemption level. Again for simplicity we are proposing a *proportional* tax on inefficiency, a tax on the deviation of actual output from the potential maximum output. The maximum potential output is now given by

$$\bar{Y} = f(\bar{L}, M) \quad (3)$$

since the maximum output is achieved when the marginal product of labour is zero and the farmer uses *all* his wealth to purchase fertilisers such that  $\lambda = 0$ . (Note  $F = (1 - \lambda)M$ , hence the maximum  $F$  is given where  $\lambda = 0$ ). Rewriting our tax function (2) using equation (3) we get

$$T = (t - \alpha)Y + \alpha f(\bar{L}, M) \quad (4)$$

it appears that our proposed tax consists of a tax on output and a tax on wealth. However, our proposed tax is a tax on output and on *unproductively used wealth* and thus avoids some of the possible disincentive effects of a wealth tax. This can be seen by noting that since  $Y = f[L, (1 - \lambda)M]$ , taxes are given by

$$T = (t - \alpha)f[L, (1 - \lambda)M] + \alpha f(\bar{L}, M) \quad (5)$$

so that by choosing a low enough  $\lambda$  the farmer can avoid part of the tax on his wealth  $M$ . Rewriting (5)

$$T = tY + \alpha f(\bar{L}, M) - \alpha f[L, (1 - \lambda)M] \quad (6)$$

One can see that, in effect, what is happening is that the government taxes the farmer's output and wealth but then returns by way of a subsidy an amount  $\alpha f[L, (1 - \lambda)M]$  which depends on the proportion of his wealth that is productively used and the amount of labour he uses in agricultural production. This is the novel feature of this tax system. In the next section we construct a simple model to analyse the effects of this tax system on the farmer's choices. In particular we show (i) that the proportion of wealth used

for money lending ( $\lambda$ ) declines as the 'inefficiency' tax rate ( $\alpha$ ) rises; and (ii) that total agricultural output rises as the 'inefficiency' tax rate increases. And as mentioned earlier a by-product of the analysis is that farmers with larger wealth use a higher proportion of it for money lending. Note, that we shall ignore the equity aspects of imposing this tax, since we are considering a fairly restrictive model.

### 3 The model

We assume a simple, static, certain, partial equilibrium world. Further, we assume that there are no markets for land and labour.<sup>5</sup> The farmer is assumed to maximise his utility function given by  $U = U(C, 1 - L)$  which is assumed to be concave and twice differentiable with  $U_1, U_2 > 0$ , (positive marginal utility of both 'goods')  $U_{11}, U_{22} < 0$  (diminishing marginal utility of both 'goods') and  $U_{12} \geq 0$  (both goods 'normal'). These restrictions on the first and second partial derivatives of the utility function are sufficient but not necessary for the concavity of  $U$ .

The farmer's consumption  $C$  is equal to the sum of his agricultural output  $Y$  and his money lending income  $r\lambda M$  less the sum of his taxes  $T$  and fertiliser costs  $(1 - \lambda)M$ . Given the tax function (2), consumption is given by

$$\begin{aligned} C &= Y + r\lambda M - [T + (1 - \lambda)M] \\ &= kY + (1 + r)\lambda M - \alpha \bar{Y} - M \end{aligned} \quad (7)$$

where  $k = 1 - t + \alpha$ . Since we do not wish taxes to be 'extortionate', it is assumed that  $k$  is positive so that  $\alpha < 1 - t$ .

The production function (1) i.e.  $Y = f(L, F)$  is assumed to be concave and twice differentiable with  $f_1 > 0$  for  $L < \bar{L}$ ,  $f_2 > 0$ ,  $f_{11} < 0$  for  $L < \bar{L}$ ,  $f_{22} < 0$ ,  $f_{12} = f_{21} > 0$  for  $L < \bar{L}$ , and  $f_{11}f_{22} - (f_{12})^2 > 0$ . For  $L \geq \bar{L}$ ,  $f_1$ ,  $f_{11}$  and  $f_{12}$  are all zero. The assumption  $f_{11}f_{22} - (f_{12})^2 > 0$  is sufficient but not necessary for the concavity of  $f$ . Basically it guarantees that first order conditions are also sufficient. The assumption  $f_{12} > 0$  corresponds to the case where the inputs are 'complementary' and is the usual assumption to make in production theory. It is certainly true of constant returns to scale production functions. As is indicated in the Appendix the Complementarity assumption is only sufficient but not necessary for Propositions 2 and 3 (below). For Proposition 1 (below) the stronger assumption of  $f_{12}$  being 'small enough' is sufficient but not necessary.

For ease of exposition, we shall make the stronger assumption of 'separability' of the production function, i.e.  $f_{12} = 0$ . This is sufficient for Propositions 1, 2 and 3. It should be emphasised that we are making this assumption for *simplicity* only. The proof in the Appendix make the more general assumption of  $f_{12} > 0$ . In the next section we indicate clearly how our propositions are affected in the more general case.

The farmer's decision problem is then to choose  $L$  and  $\lambda$  so as to maximise his utility given by  $U(C, 1 - L)$  where his consumption is given by (7), output is given by (1) and  $F = (1 - \lambda)M$ . This can be written as:

Max  $U(C, 1 - L)$  subject to the constraints:

$$\begin{aligned} C &= kY + (1 + r)\lambda M - \alpha\bar{Y} - M, \\ Y &= f(L, F) \end{aligned}$$

and

$$F = (1 - \lambda)M.$$

Substituting the constraints into the utility function yields the first order conditions as:

$$\frac{\partial U}{\partial L} = 0 \text{ and } \frac{\partial U}{\partial \lambda} = 0.$$

These by virtue of the concavity of  $U$  and  $f$  are also sufficient conditions.

$$\frac{\partial U}{\partial L} = U_1 k f_1 - U_2 \quad (8)$$

$$\frac{\partial U}{\partial \lambda} = U_1 [-k f_2 M + (1 + r)M] \quad (9)$$

Since  $U_1 > 0$ , (8) and (9) yield as first order conditions:

$$U_1 k f_1 = U_2 \quad (10)$$

and

$$k f_2 = 1 + r. \quad (11)$$

These conditions are easily interpreted,  $U_2$  is the marginal utility of leisure and  $k f_1$  the net (of taxes) marginal product of labour. Thus  $U_1 k f_1$  is the net (derived) marginal utility of labour. Hence (10) merely asserts that the net marginal utility derived from labour equals the marginal utility of leisure. Similarly  $(k f_2 - 1)$  is the net marginal return on fertilisers while  $r$  is the marginal return from money-lending which is the alternative to fertilisers. Thus (11) merely asserts that the farmer allocates his wealth in such a way that the net marginal return from each of the uses of wealth is equal.

Equations (10) and (11) can be solved for  $\lambda^*$  and  $L^*$ , the farmer's optimal choices. Separability of the production function ( $f_{12} = 0$ ) implies that  $f_2$

depends on  $F$  alone. This has the consequence that  $\lambda^*$  can be solved from (11) alone and then (10) can be solved for  $L^*$ . Thus separability allows (10) and (11) to be treated as a partitioned system of equations which can be solved sequentially rather than simultaneously. We shall now employ a simple diagrammatic apparatus to investigate the consequences of changes in  $M$  and  $\alpha$  on the farmer's optimal choices.

Rewriting (11) as

$$f_2 = \frac{(1+r)}{k} = p_f \quad (12)$$

where  $p_f$  is the shadow price of fertilisers, we may represent (12) by means of diagram 1.

In diagram 1,  $f_2$  is the marginal product of fertilisers. By the separability assumption, the position of  $f_2$  is fixed independently of the level of  $L$ . Hence, given the initial implicit price  $p_f^* = (1+r)/k$ , the optimal purchase of fertilisers can be read from the  $f_2$  curve as  $F^*$ . Given  $F = (1-\lambda)M$ , this immediately yields  $\lambda^*$  as

$$\lambda^* = 1 - \frac{F^*}{M} \quad (13)$$

Furthermore, since neither  $p_f$  nor  $f_2$  depends on  $M$ , the solution for  $F^*$  does not depend on  $M$ . Hence from (13), it is clear that a rise in  $M$  will leave  $F^*$  unaffected and thus increase  $\lambda^*$ . Thus we obtain:

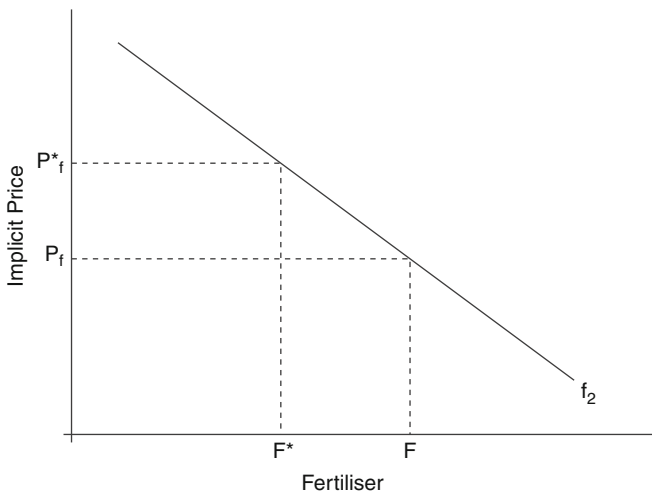


Figure 2.4.1 Diagram 1



*Proposition 1*

$$\frac{d\lambda^*}{dM} > 0 \quad (14)$$

i.e. wealthier farmers lend a higher proportion of their wealth and use a lower proportion for productive activities.

Furthermore, it is obvious from (12) that an increase in  $\alpha$ , the 'inefficiency' tax rate merely lowers  $p_f$  to, say,  $\hat{p}_f$ . This implies that the marginal product of fertilisers must fall and this is accomplished by increasing fertiliser purchases to  $\hat{F}$ . Hence an increase in  $\alpha$  increases the purchase of fertilisers ( $dF^*/d\alpha > 0$ ) and consequently lowers  $\lambda^*$  as  $\lambda = 1 - F/M$ . This yields:

*Proposition 2:*

$$\frac{d\lambda^*}{d\alpha} < 0 \quad (15)$$

i.e. an increase in the 'inefficiency' tax rate reduces the proportion of wealth lent and increases the proportion of wealth productively used (to buy fertilisers) for all farmers independently of their wealth level.

We have already shown that an increase in  $\alpha$  leads to an increased purchase and use of fertilisers, ( $dF/d\alpha > 0$ ). We can further show that increased  $\alpha$  leads to an increase in the only other input to production viz. labour, so that output must rise as  $\alpha$  rises. An heuristic proof is outlined below for the case where  $f_{12} = 0$  and  $U_{12} = 0$  whilst the formal proof for the general case (where  $U_{12} > 0$   $f_{12} > 0$ ) is contained in the Appendix.

Rewriting (10) as

$$f_1 = \frac{U_2/U_1}{k} = p_L \quad (16)$$

where  $p_L$  is the shadow price of labour, we can, as before, resort to a simple diagram.

Diagram 2 is similar to Diagram 1.  $f_1$  is the marginal product of labour curve and, by the separability of the production function is independent of the level of  $F^*$ . Let  $L^*$  be the initial optimal choice and  $p_L^*$  the corresponding shadow price of labour. An increase in  $\alpha$  affects  $p_L^*$  and hence  $L^*$ . Suppose that an increase in  $\alpha$  lowers  $L^*$  to  $\hat{L}$ . Then from Diagram (2),  $p_L^*$  must obviously rise to  $\hat{p}_L$ . We shall show that this involves a contradiction by demonstrating that an increase in  $\alpha$  which lowers  $L^*$  must lower  $p_L^*$ .

From (7), it follows that

$$dC^* = (Y^* - \bar{Y}) d\alpha + kf_1 dL^* - kf_2 Md\lambda^* + (1+r) Md\lambda^*$$

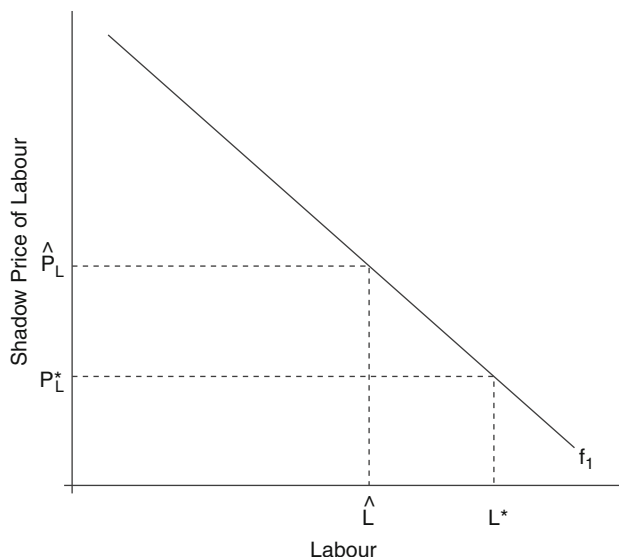


Figure 2.4.2 Diagram 2

and the last two terms in the expression above cancel because of the first order condition (11). Hence

$$dC^* = (Y^* - \bar{Y})d\alpha + kf_1 dL^* \quad (17)$$

From (14) it is obvious that  $d\alpha > 0$ ,  $dL^* < 0 \Rightarrow dC^* < 0$ . i.e. an increase in  $\alpha$  which lowers  $L^*$  must also lower  $C^*$ . But a lower consumption implies a higher marginal utility of consumption (since  $U_{11} < 0$ ) so that  $U_1$  must rise. Similarly, the decline in  $L^*$  increases leisure and hence lowers its marginal utility. Thus  $U_2$  falls. Finally an increase in  $\alpha$  raises  $k$ . Thus  $d\alpha > 0$ ,  $dL^* < 0$  implies  $d(U_1^*) > 0$ ,  $d(U_2^*) < 0$ ,  $dk > 0$ . Since

$$p_L^* = \frac{U_2^*/U_1^*}{k},$$

the fall in  $U_2^*$ , the rise in  $U_1^*$  and rise in  $k$  implies a fall in  $p_L^*$ . Thus increased  $\alpha$  and decreased  $L^*$  implies a fall in  $p_L^*$ . Hence the contradiction. Thus a rise in  $\alpha$  must be accompanied by either an increase or no change in  $L^*$ . Given that a rise in  $\alpha$  increases  $F^*$ , it follows that output must rise. This is our:

*Proposition 3:*

$$\frac{dY^*}{d\alpha} > 0 \quad (18)$$

i.e. an increase in the inefficiency tax rate increases output because it increases fertiliser use and increases (or does not decrease) labour use.

#### 4 Some qualifications

The main results obtained from our model are Propositions 1, 2 and 3. These, in particular Proposition 3, are quite strong. Not surprisingly such strong results can be obtained only by making strong assumptions. In this section we discuss the implications of relaxing these assumptions. We also discuss some administrative problems of implementing the tax.

We begin by noting that the assumption of separability of the production function ( $f_{12} = 0$ ) is not critical. In the Appendix we have derived necessary and sufficient conditions for our three propositions. These conditions (equations (viii), (ix) and (xi) in the Appendix) are messy and do not have any simple economic interpretation. However the assumption of Complementarity of inputs ( $f_{12} > 0$ ) is a weak sufficient condition for Propositions 2 and 3. In the case of Proposition 1, the weakest sufficient condition which has any economic interpretation is  $f_{12}$  should be 'small enough'. The case discussed in the previous section viz.,  $f_{12} = 0$  is clearly a limiting case of  $f_{12}$  'small enough'.

We have also assumed that all money lending activity results in 'conspicuous consumption' on the part of the borrower. If, however, part of the money borrowed is used for productive purpose by the borrowers, then Proposition 3 needs modification. Increased  $\alpha$  curtails money lending activity and hence to the extent that some part of money borrowed is used for productive purposes, then the output of the borrowers will fall. Aggregate output will still rise if this fall is more than offset by the rise in output of the lenders. In the presentation of our model we have in effect assumed that the productive use of funds borrowed from money lenders is negligible.

Finally we have assumed that the agricultural output tax is proportional. We could easily allow for an exemption level  $E$  which would then make the output tax progressive. The tax function would then be:

$$T = t(Y - E) + \alpha(\bar{Y} - Y).$$

This would not affect any of the results in the paper as changes in  $E$  do not affect any of the marginal conditions. Furthermore this formulation has the added advantage of demonstrating quite easily that the government could easily maintain a constant tax revenue by introducing changes in  $E$  which would compensate for changes in  $\alpha$ .

In our model we have also assumed that there is no land market, in particular we have ignored the institution of tenancy and therefore the income from it. A more 'realistic' model should allow for tenancy. However, changes

in social, economic and technological factors have led to a decrease in tenancy in some LDCs, e.g. India. This should make our model more applicable. Unfortunately, although official statistics for India suggest a decline in tenancy because of legal restrictions, the reality is different. We may, therefore, be ignoring an important component of untaxed agricultural income.

In our model we have assumed the absence of a labour market. This is a simplifying assumption which we are relaxing in our further research. (Introducing a classical labour market with unlimited labour-supply would leave our results unchanged). Specifically, we shall allow for 'interlinking' between the credit and labour market.<sup>6</sup> In further work we shall extend the analysis to different classes within the agricultural sector and allow for a general equilibrium determination of quantities and prices.

In our analysis of the inefficiency tax we have ignored its impact on equity. If we had two groups of farmers, one money-lending and the other not, this tax would clearly increase income of the money lending group *vis à vis* the other group. This increased inequality could be corrected by the Government spending its tax revenue on providing subsidised inputs for the non-money lending group. However, this may be administratively difficult. In any case a proper analysis of the effects of this tax on equity would have to be carried out in a general equilibrium context.

Finally, we discuss some issues of administering the inefficiency tax and avenues for further research. We think that the suggested tax system has the virtue of simplicity and its requirements on information are no greater than for the Agricultural Holdings Tax. We require information on agricultural *output*, not on agricultural *income*. Hence we need not worry about problems of imputing costs or deciding on the distinction between capital and current costs. If we assume, which is not unrealistic, that money or wealth holdings are proportional to (or some positive function of) land ownership we can compute a maximum potential output in a way analogous to the AHT. We would, of course, still have a problem (so do other tax proposals) in obtaining accurate (honest) information on land-ownership. This, however, is something which can be improved with the exercise of a strong and determined government. Problems of enforcement would be no different whichever tax system is operated.

We have assumed away problems of uncertainty so that the measure of maximum potential output  $\bar{Y}$  and inefficiency  $(\bar{Y} - Y)$  is unambiguous.<sup>7</sup> It should, however, be noted that, in practice, the calculation of  $\bar{Y}$  is not easy. With different crops and variable input and output prices,  $\bar{Y}$  is no longer unambiguously defined. Even without such considerations, one would have to use an averaging procedure over a few years (as suggested by the Raj Committee) to determine  $\bar{Y}$ . These are important practical matters that would have to be looked into before this tax could be taken seriously by policy makers.

## 6 Conclusions

We have demonstrated, in a simple model, that (i) the proportion of money lent increases with wealth, (ii) the proportion of money lent decreases with an increase in the tax rate on inefficiency and (iii), agricultural production increases with an increase in the tax rate on inefficiency. These conclusions were reached without making Raj's arbitrary assumption that farmers try to minimise their tax burden but, rather, that they seek to minimise a very conventional looking utility function. Thus the *potential* usefulness of an 'inefficiency tax' similar in spirit to AHT does *not* depend on farmers behaving in a highly unconventional manner. This does not vitiate concerns regarding the implementation of the tax or other possibly negative effects that it may have. We have indicated some of the main problems in those directions. However, if the model is taken at face value, it implies that if we want to increase agricultural production, we should, *firstly*, impose a tax on inefficiency and, secondly, redistribute land (wealth).

The analysis in this paper is a first step in studying an important problem. Further work needs to be done in extending this model. Firstly, we need to extend the model to a two-sector economy where the agricultural output price is determined in a general equilibrium framework. Secondly, we need to extend the model to allow for saving and investment and to buying and selling of labour and land.

## Appendix

Proof of Propositions (1), (2) and (3). We shall deal with (1) last.

Assumption: (I)  $U$  is concave and  $U_1, U_2 > 0$ ,  $U_{11} < 0$ ,  $U_{22} < 0$ ,  $U_{12} \geq 0$  i.e. Both leisure and consumption are 'normal' goods.

(II)  $f$  is concave, i.e.  $f_1, f_2 > 0$ ,  $f_{11}f_{22} < 0$  and  $f_{11}, f_{22} - (f_{12})^2 > 0$ . Also the inputs are 'complementary' i.e.  $f_{12} > 0$ .

$$\text{FOC are: } kf_1 = \frac{U_2}{U_1} = g(C, 1 - L) \quad (\text{i})$$

$$\text{and } kf_2 = 1 + r \quad (\text{ii})$$

Differentiate (i) and (ii) totalling allowing  $\alpha$  and  $M$  to change.

$$\begin{aligned} \text{From (i) } [kf_{11} - kf_1g_1 + g_2]dL^* + [-kMf_{12}]d\lambda^* \\ = [g_1\{Y^* - \bar{Y}\} - f_1]d\alpha + [g_1\{(1+r)\lambda^* - 1\} - kf_{12}(1 - \lambda^*)]dM \end{aligned} \quad (\text{iii})$$

$$\text{From (ii) } [kf_{12}]dL^* + [-kMf_{22}]d\lambda^* = [-f_2]d\alpha + [-kf_{22}(1 - \lambda^*)]dM \quad (\text{iv})$$

(iii) and (iv) can be rewritten as:

$$a_{11}dL^* + a_{12}d\lambda^* = b_1d\alpha + c_1dM \quad (\text{v})$$

$$a_{21}dL^* + a_{22}d\lambda^* = b_2d\alpha + c_2dM \quad (\text{vi})$$

where the  $a_{ij}$ 's,  $b_i$ 's and  $c_i$ 's are the terms in square parentheses in (iii) and (iv). Define

$$\begin{aligned}\Delta &= \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} \cdot a_{22} - a_{21} \cdot a_{12} \\ &= -kMf_{22} \left\{ k \frac{[f_{11}f_{22} - (f_{12})^2]}{f_{22}} - kf_1g_1 + g_2 \right\}\end{aligned}$$

As by concavity of  $f$ ,  $[f_{11}f_{22} - (f_{12})^2] > 0$  and also  $f_{22} < 0$ ,  $f_1g_1 > 0$ ,  $g_2 < 0$

$$\therefore \Delta < 0 \quad (\text{vii})$$

(N. B. This result does not require  $f_{12} > 0$ ;  $f_{12} < 0$  will also do).

To obtain the effects of changing  $\alpha$ , set  $dM = 0$

$$\begin{aligned}\Rightarrow \frac{d\lambda^*}{d\alpha} &= \frac{a_{11}b_2 - a_{21}b_1}{\Delta} \\ &= \frac{-(kf_{11} - kf_1g_1 + g_2)f_2 + kf_{12}\{g_1(Y^* - \bar{Y}) - f_1\}}{\Delta} \\ \therefore \frac{d\lambda^*}{d\alpha} &< 0 \Leftrightarrow [(kf_{11} - kf_1g_1 + g_2)f_2 + kf_{12}\{g_1(Y^* - \bar{Y}) - f_1\}] < 0 \quad (\text{viii})\end{aligned}$$

$\Rightarrow f_{12} > 0$  is sufficient but *not* necessary for

$$\frac{d\lambda^*}{d\alpha} < 0 \quad (\text{Proposition 2})$$

Similarly

$$\begin{aligned}\frac{dL^*}{d\alpha} &= \frac{b_1a_{22} - b_2a_{12}}{\Delta} \\ &= \frac{\{g_1(Y^* - \bar{Y}) - f_1\} + f_2/f_{22} \cdot f_{12}\{-kMf_{22}\}}{\Delta} \\ \Rightarrow \frac{dL^*}{d\alpha} &> 0 \Leftrightarrow [\{g_1(Y^* - \bar{Y}) - f_1\} + \frac{f_2}{f_{22}} \cdot f_{12}\{-kMf_{22}\}] < 0 \quad (\text{ix})\end{aligned}$$

Again  $f_{12} \geq 0$  is sufficient but *not* necessary for  $dL^*/d\alpha > 0$ .

Proposition 3 now follows directly as

$$\frac{dY^*}{d\alpha} = f_1 \frac{dL^*}{d\alpha} - M f_2 \frac{d\lambda^*}{d\alpha} > 0$$

Obviously  $f_{12} \geq 0$  is sufficient but *not* necessary for Proposition 3.

For Proposition 1, set  $d\alpha = 0$  and hence

$$\begin{aligned}\frac{d\lambda^*}{dM} &= \frac{N}{\Delta} \text{ where } N = a_{11}c_2 - a_{21}c_1 \\ \Rightarrow N &= \{kf_{11} - kf_1g_1 + g_2\}\{-kf_{22}(1 - \lambda^*)\} \\ &\quad - [kf_{21}][g_1\{(1 + r)\lambda^* - 1\} - kf_{12}(1 - \lambda^*)]\end{aligned} \quad (\text{x})$$

$$\text{As } \Delta < 0, \frac{d\lambda^*}{dM} > 0 \Leftrightarrow N < 0 \quad (\text{where } N \text{ is given (x)}) \quad (\text{xi})$$

The first part of  $N = (k f_{11} - k f_{12} g_1 + g_2) \{-k f_{22}(1 - \lambda^*)\}$  is clearly negative. Hence if the second is either negative or zero, then  $N < 0$ . The second part of  $N$

$$= -k f_{12} [g_1 \{(1 + \gamma) \lambda^* - 1\} - k f_{12} (1 - \lambda^*)] = 0$$

if  $f_{12} = 0$  so that  $N < 0$ . If, however,  $f_{12} > 0$ , then so long as  $f_{12}$  is 'small enough', the term in square parentheses above is positive and hence  $N < 0$ . i.e.  $f_{12}$  'small enough' is sufficient but *not* necessary for  $d\lambda^*/dM > 0$ . It has also been shown that  $f_{12} = 0$  (which is the limiting case of  $f_{12}$  'small enough') is also sufficient for  $d\lambda^*/dM > 0$ .

## Notes

We should like to thank, without implicating, Roy Bailey for helpful discussions on the subject and Professor A. A. G. Ali for suggesting a proof for a more general case. We are grateful to anonymous referees for helpful comments.

1. For a discussion of the Raj Committee report, see Toye (1978) and Rao (1972). Also see Junankar (1972) for an alternative tax based on wealth.
2. See Berry & Cline (1979). There are problems about defining productivity. However, since land is *the* scarce factor in most LDCs, productivity is usually defined as output per hectare.
3. We would readily agree that there are other approaches and theoretical models which are consistent with the inverse relation. See, for example, Ghose (1979).
4. We assume that 'fertilisers' are a composite of *all* purchased inputs. Assuming relative prices of these inputs remain unchanged, we can use Hicks' composite good theorem to justify this simplification. Wage labour could also be included subject to the above restrictions.
5. If we assumed a classical labour market with 'unlimited' labour supply our propositions would remain unaffected.
6. See Bardhan (1980) and references cited therein.
7. We are, of course, ignoring all the theoretical problems associated with uncertainty models of the agricultural sector.

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# 3

## Poverty, Mobility and Inequality

# 3.1

## Poverty in India: A Comment

P. N. Junankar

In a long and well-documented paper Dandekar and Rath [1] reach two major policy conclusions. Firstly, that the policy of imposing land ceilings would lead to fragmented and uneconomical holdings. In addition, the working of a free market economy would lead to a *de facto* (though not *de jure*) reconsolidation of land. They argue that a 'patently uneconomic proposition cannot be sustained by law'.<sup>1</sup> As an alternative policy to alleviate poverty they suggest a massive public works programme 'to enable the 30 per cent rural poor living below the desired minimum (excluding the 10 per cent poorest) to reach the minimum consumer expenditure ...' This would be financed by the top 5 per cent of the rich agreeing 'to a cut of a *mere* 15 per cent in their consumer expenditure' and another 5 per cent 'have to agree to a cut of a *mere* 7.5 per cent in their consumer expenditure'.<sup>2</sup>

It is the contention of this note that Dandekar and Rath's suggestion for a massive public works programme cannot 'meet the claims of the poor within the framework of private ownership of the means of production'.<sup>3</sup> I shall argue that the increase in taxation required to finance the public works programme will be sufficiently large to have serious disincentive effects. In addition, the collection costs would be large (if not infinitely large!) and politically in the realm of the impossible (within the present socio-political structure).

First, I shall give an indication of the increase in taxation required. D and R are aware of this problem: 'the income tax on non-agricultural incomes will have to be raised considerably' and 'large agricultural incomes will have to be brought under corresponding taxation'.<sup>4</sup> But 'a major part ... must be collected by indirect taxes on all luxury goods which go into the consumption of the richer classes'.<sup>5</sup> Let us first *assume* that there is no

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change in the rate (or coverage) of indirect taxes. The Table gives the *increase* in the tax rate required to obtain a 15 per cent decrease in consumption expenditure.<sup>6</sup>

It is clear from this illustration that the percentage increase in the tax rate to obtain the 15 per cent decrease in consumption expenditure (assuming no indirect taxes) is very high for any reasonable estimate of the existing tax rate. In addition, if it is noted that the rural sector pays virtually no direct taxes and D and R require this sector to pay Rs 636.7 crores annually it seems to be asking for the impossible. D and R suggest that indirect taxes can be raised by, for example, taxing cars (how many rural people own cars?); luxury apartments in cities (the rural rich rarely diversify to this extent); cloth, tobacco, liquor – but those are regressive taxes! It is worth repeating that the amount of taxes to be raised from the rural rich relative to the urban rich (according to D and R estimates) is in the ratio of approximately 3 to 1. The indirect taxes suggested by D and R mainly affect the urban rich. To obtain the Rs 636.7 crores from the rural rich would require a major new agricultural tax at a very high marginal rate. These substantial increases in the tax rate are likely to lead to serious disincentive effects. They would also lead to large-scale attempts at evasion and hence frustrate the tax collection. An alternative form of collecting taxes from the rural rich, which would be a once-for-all affair and hence not have disincentive effects, would be to impose a land ceiling which is analogous to a wealth tax.<sup>7</sup>

Let me now turn to the difficulties of collecting these increased taxes. The costs of collecting these taxes would be almost prohibitive – to obtain anything like accurate (and honest) records from the rural sector would require a team of tax collectors that might outnumber the rural rich! Taxing the urban rich also seems difficult with various transactions being un-recorded or under-recorded. A massive increase in the tax rate would increase the incentive to evade tax payment.

Finally, a brief look at the political difficulties. It has been often stated that in spite of various reforms, the political process in villages is ‘controlled’ by the rural rich. Given this socio-political structure it seems like asking a government to commit political suicide to impose massive taxes on the rural rich. But this applies equally to any other suggested reforms for redistribution within the existing structure.

To conclude, D and R’s policy conclusion for a massive public works programme although laudable seems to require tax collection on a scale that would have disincentive effects, would be difficult to police, and is politically unrealistic. To obtain the redistribution of income on the scale required to bring up the 30 per cent below the minimum standard (that has so impressively been quantified by D and R) seems to require more than a radical change of the ‘norms of taxation’. The ‘framework of private ownership of the means of production’ would not be able to withstand the shock!

## Appendix

- Assume (1) Proportional taxation (at least within certain tax brackets)  
 (2) Consumption a proportional function of disposable income  
 (3) Income is exogenous and constant.

### Example

$C$ =Consumption;  $Y$ =income;  $t$ =tax rate

$$C = c(1-t)Y = cY - cYt$$

$$dC = cdY - ctdY - cYdt$$

By assumption (3)  $dY=0$ , hence  $dC = -cYdt$

$$\frac{dC}{C} = -\frac{cY}{C}dt$$

$$dt = -\frac{dC}{C} \frac{C}{cY}$$

For a 15 per cent decrease in Consumption

$$\frac{dC}{C} = -\frac{15}{100}$$

$$\therefore dt = \frac{15}{100} \frac{C}{cY}$$

To solve take some  $Y$ , eg,  $Y=500$ , calculate  $C$  for given  $c$  and  $t$ . (The choice of  $c$  does not affect the results).

$$\text{Let } c = \frac{8}{10}, t = \frac{1}{10}$$

Table 3.1.1 Table 1

| Initial<br>Tax Rate | Absolute Increase<br>in Tax Rate | Percentage Increase<br>in Tax Rate |
|---------------------|----------------------------------|------------------------------------|
| 10/100              | 13.5/100                         | 135.00                             |
| 20/100              | 12/100                           | 60.00                              |
| 30/100              | 10.5/100                         | 35.00                              |
| 40/100              | 9/100                            | 22.50                              |
| 50/100              | 7.5/100                          | 15.00                              |
| 60/100              | 6/100                            | 10.00                              |
| 70/100              | 4.5/100                          | 6.43                               |
| 80/100              | 3/100                            | 3.75                               |

$$\begin{aligned}
C &= \frac{8}{10} \left(1 - \frac{1}{10}\right) Y \\
&= \frac{8}{10} \cdot \frac{9}{10} \cdot 500 = 360 \\
dt &= \frac{15}{100} \cdot 360 \cdot \frac{10}{8} \cdot \frac{1}{500} \\
&= \frac{135}{1000} \\
\frac{dt}{t} \cdot 100 &= \frac{135}{1000} \cdot 100 \cdot \frac{10}{1} \\
&= 135\%.
\end{aligned}$$

## Notes

1. Dandekar and Rath [1], henceforth D and R; p 121.
2. *Ibid* pp 142–3. Emphasis added.
3. *Ibid* p 146.
4. *Ibid* p 144.
5. *Ibid* p 144.
6. The details for the derivation are given in the Appendix. The assumptions made for the calculations are also provided there.
7. See Junankar [2].

## References

- [1] Dandekar, V M and Rath, N: “Poverty in India”, *Economic and Political Weekly*, January 2 and 9, 1971.
- [2] Junankar, P N: “Land Ceilings as a Tax on Agriculture: A Note”, *Economic and Political Weekly*, Review of Agriculture June 24, 1972.

## 3.2

# Green Revolution and Inequality

P. N. Junankar

*An inevitable consequence of the Green Revolution has been increasing inequality in rural India. As the high-yielding varieties of crops require regular supply of irrigation and fairly large amounts of fertilisers, the advantage has been biased towards the large farms. These farms have also begun to substitute capital (e.g., tractors) for labour. Since the new varieties are profitable there would be an increase in capitalist farming, an attempt by landlords to evict their tenants and cultivate the land with hired labour, and an attempt by large farmers to buy out small farmers as far as the land ceiling legislation will stretch.*

*In this paper the author presents some empirical evidence from the Ferozepur district of Punjab, to suggest that inequality is increasing in the agricultural sector. The question of the impact of the Green Revolution on employment and wages is not covered here. Empirical evidence on strictly 'farm' incomes and farm size as an index of wealth ownership is looked at.*

*The data used are from the Farm Management Studies for the Ferozepur district of Punjab, for 1968–69 and 1969–70. The approach is to trace, over the period, the changes in the distribution of farm size (wealth); to compare changes in the distribution of Farm Business Income over the period; and then to compare the income distribution with the wealth distribution. The data are for 150 farms chosen on a multi-stage stratified random basis. The advantage of this method of making a comparison over a short period is that changes in each farm can be identified. The disadvantage of this method is that there may not be very many changes in such a short time and, in any case, they may be random ones rather than systematic ones.*

*[I would like to thank the Nuffield Foundation for financial support; Alan J Harrison for his computer programme on inequality measures; Jill Smith and Rachel Britton for competent research assistance.]*

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## Some Results

In a recent paper, Bardhan (1974) used Farm Management Studies data from four districts (Ferozepur in Punjab, Muzaffarnagar in UP, Hooghly in West Bengal, and Ahmednagar in Maharashtra) to compare income distribution in the mid-1950s with the distribution in the late 1960s. Using Farm Business Income, he finds that there is an unambiguous increase in inequality in Ahmednagar and an unambiguous decrease in inequality in Muzaffarnagar. For the other two districts, the Lorenz curves intersect and thus an evaluation of inequality requires explicit value judgments.<sup>1</sup> However, using a Gini co-efficient ('concentration ratio'), inequality of Farm Business Income has increased in all districts – except Muzaffarnagar. But, in contrast, using Gini co-efficients for Farm Size, he finds that inequality has increased *marginally* for Ferozepur and Ahmednagar, decreased *marginally* for Hooghly, and decreased for Muzaffarnagar. An interesting result is that, for all districts, the Gini co-efficient is *higher* for Farm Business Income (income inequality) than for Farm Size (wealth inequality). This latter result, he explains in terms of the economies of scale enjoyed by large farms.

I now turn to the results obtained for Ferozepur 1968–69 and 1969–70. For the income distribution, I used data on Farm Business Income; while for farm size, I have used three alternative definitions. The first one, is area owned by the farmer. In 1968–69 only one farmer was a pure tenant (i.e., he did not own any land), but by 1969–70 there were three pure tenants. The second definition, Farm Size A, is the area owned plus the area leased in minus the area leased out. The third definition, Farm Size B, was the net sown area. Each of these definitions has its own attractions. The area owned is the 'cleanest' definition of the wealth, and hence power, enjoyed by the farmer. Farm Size A is more closely related to how much land the farmer could potentially cultivate. A rich farmer would be able to lease in additional land if he found agriculture becoming more profitable. Farm Size B is really an indication of the farmer's expectations of crop prices and input prices, given the quality of land. We would expect farmers to increase the proportion of their farm cultivated, because of the Green Revolution, and this in turn to increase inequality of Farm Size B.<sup>2</sup>

Table 3.2.1 contains cumulative distributions of Area Owned, Farm Sizes A and B, and Farm Business Income for 1968–69 and 1969–70. Gini co-efficients are presented in the bottom line of the Table. The Gini co-efficient has been calculated only for *positive* values of the variables, and hence the minor changes in sample size. Since the Lorenz curves for Farm Size B and Farm Business Income do not intersect, we have no difficulty in interpreting the Gini co-efficients. However, the Lorenz curves for Area Owned and Farm Size A cross very marginally and there may be some ambiguity in interpreting the Gini co-efficient. Since these intersections are minor, I shall ignore them for the time being and return to them later.

Table 3.2.1 Gini co-efficients

| Per Cent          | 1968-69          |             |             |                      |                  | 1969-70     |             |                      |              |  |
|-------------------|------------------|-------------|-------------|----------------------|------------------|-------------|-------------|----------------------|--------------|--|
|                   | Area Owned       | Farm Size A | Farm Size B | Farm Business Income | Area Owned       | Farm Size A | Farm Size B | Farm Business Income | (Percentage) |  |
| Top 1             | 4.77             | 4.54        | 3.23        | 7.19                 | 4.72             | 4.52        | 4.40        | 6.21                 |              |  |
| 5                 | 16.60            | 16.00       | 14.79       | 24.31                | 16.53            | 16.08       | 16.16       | 22.71                |              |  |
| 10                | 27.76            | 25.77       | 24.23       | 35.84                | 28.40            | 26.56       | 26.59       | 34.54                |              |  |
| 15                | 36.35            | 33.83       | 32.46       | 45.16                | 37.33            | 34.80       | 34.93       | 44.15                |              |  |
| 20                | 43.75            | 41.33       | 39.95       | 52.98                | 44.89            | 42.17       | 42.47       | 52.53                |              |  |
| 25                | 50.56            | 48.14       | 46.82       | 59.87                | 51.85            | 48.77       | 49.33       | 59.55                |              |  |
| 30                | 56.69            | 54.34       | 53.05       | 65.90                | 58.03            | 55.07       | 55.75       | 65.22                |              |  |
| 35                | 62.25            | 59.99       | 58.71       | 70.99                | 63.63            | 60.81       | 61.56       | 70.18                |              |  |
| 40                | 67.26            | 65.21       | 63.96       | 75.38                | 68.73            | 66.04       | 66.67       | 74.35                |              |  |
| 45                | 71.81            | 70.04       | 68.94       | 79.19                | 73.20            | 70.76       | 71.23       | 78.06                |              |  |
| 50                | 75.86            | 74.50       | 73.53       | 82.47                | 77.14            | 74.89       | 75.33       | 81.42                |              |  |
| 55                | 79.49            | 78.45       | 77.79       | 85.45                | 80.71            | 78.71       | 79.09       | 84.51                |              |  |
| 60                | 82.85            | 82.07       | 81.60       | 88.11                | 83.94            | 82.17       | 82.51       | 87.28                |              |  |
| 65                | 85.99            | 85.29       | 84.89       | 90.49                | 86.99            | 85.35       | 85.70       | 89.84                |              |  |
| 70                | 88.89            | 88.19       | 87.89       | 92.62                | 89.76            | 88.35       | 88.63       | 92.12                |              |  |
| 75                | 91.49            | 90.87       | 90.57       | 94.48                | 92.17            | 91.10       | 91.33       | 94.16                |              |  |
| 80                | 93.79            | 93.27       | 93.06       | 96.17                | 94.21            | 93.54       | 93.68       | 95.90                |              |  |
| 85                | 95.82            | 95.47       | 95.33       | 97.61                | 95.98            | 95.65       | 95.72       | 97.34                |              |  |
| 90                | 97.55            | 97.40       | 97.29       | 98.83                | 97.59            | 97.41       | 97.53       | 98.59                |              |  |
| 95                | 99.02            | 98.94       | 98.89       | 99.69                | 99.01            | 98.89       | 99.03       | 99.59                |              |  |
| Sample size       | 149 <sup>f</sup> | 150         | 150         | 145*                 | 147 <sup>f</sup> | 150         | 150         | 147*                 |              |  |
| Gini <sup>†</sup> | 0.3759           | 0.3510      | 0.3349      | 0.4884               | 0.3921           | 0.3589      | 0.3651      | 0.4747               |              |  |

Notes: <sup>†</sup>Two farmers became landless over the period.

\*There are fewer farms with &lt;0 Farm Business Income in 1969-70.



First, let us compare the inequality of land owned with Farm Size A, Farm Size B, and Farm Business Income. Our results show that, for both years, 1968–69 and 1969–70, the inequality of Farm Business Income is greater than the inequality of land ownership, Farm Sizes A or B. This result supports Bardhan's (1974) findings. Economies of scale seem to favour the larger farmer, and thus lead to greater inequality in income distribution compared to 'wealth' distribution. Again, for both years, the inequality of land ownership is greater than the inequality of Farm Size A or B. This suggests that the practice of leasing in and leasing out land seems to lead to greater equality of effective farm size. This is an interesting result, since it implies that even though there are increasing returns to scale they are not sufficiently large (or not perceived to be sufficiently large) to prevent the large farmers from leasing out some of their land.<sup>3</sup>

Now, comparing the changes over time, we find that inequality of land ownership and Farm Size (A or B) has increased from 1968–69 to 1969–70. The increases in the Gini co-efficient are not very large – which is not surprising as the time period chosen is so short – and the increase for Farm Size A is virtually negligible. What is interesting is that for 1968–69 there is greater inequality according to Farm Size A than for Farm Size B, while for 1969–70 this is reversed. The result for 1968–69 supports Bardhan's contention that the larger farms leave a larger proportion of their land fallow and thus inequality of Farm Size B would be less than for Farm Size A. But, as we argued above, with the Green Revolution farmers would *increase* the proportion of their land cultivated and we would expect a closing of the gap between the inequality measured for Farm Sizes A and B. This is, in fact, what we observe: the inequality of Farm Size B has increased by a larger amount than of Farm Size A. Finally, we observe a slight *decrease* in inequality of Farm Business Incomes. This is a slightly puzzling result and one possible explanation is that it is a purely random occurrence – due to, say, weather fluctuations. Some support for this view comes from our earlier finding – that inequality of Farm Size B (net sown area) had increased and if there were economies of scale then Farm Business Income inequality should also have increased.

Since the interpretation of income inequality as measured by, say, a Gini co-efficient is ambiguous where Lorenz curves intersect, I shall now present results using Atkinson's Index.<sup>4</sup> This index (also called the "Equally Distributed Equivalent Index") makes explicit value judgments about whether we attach more weight to the lower end of the distribution and less weight to transfers at the top.

$$I \equiv \left[ 1 - \sum_i \left( \frac{y_i}{\mu} \right)^{1-\epsilon} f(y^i) \right]^{1/1-\epsilon}$$

where  $\mu$  is the mean of the distribution and  $\epsilon$  (epsilon) is the inequality aversion parameter. A higher  $\epsilon$  implies a larger weight to transfers at the lower end of the distribution.

Table 3.2.2 contains the results using this index for selected values of epsilon. These results, in general, support our earlier conclusions. For any given value of  $\epsilon$ , there is still the same ranking of the different variables. There are some striking conclusions we can draw if we postulate an inequality aversion value (say  $\epsilon=2$ ). In 1968–69, we would only require 62 per cent of the area owned to give the same social welfare if land were equally distributed. For Farm Business Income only 30 per cent (!) of it would be required to give the same social welfare if it were equally distributed. Since a Gini co-efficient gives greater weight to the middle range, it is not the most appropriate index to use in countries such as India. These results suggest that there is a pretty high degree of inequality which has increased from 1968–69 to 1969–70, *except* in terms of Farm Business Income.

As Dantwala and Rao (1974) have pointed out, summary statistics may be misleading. Following their suggestion, I shall now try to look at ‘the process of change in the distribution over time ... such as movements of farmers up or down the “agricultural ladder”’ (p. 801). One result of this analysis was that there was a surprisingly large amount of movement in a short time period (from 1968–69 to 1969–70).

In Table 3.2.3, we illustrate some of the movement taking place along the ‘agricultural ladder’. The Table presents the changing ownership of land from 1968–69 to 1969–70. Using the initial year for classification purposes, we see that 29 farms *increased* their area owned, 36 farms *decreased* in size, and 85 farms did not change in size. (I have treated changes in farm size of  $\pm 0.5$  hectares as if there was no change.) The top half of the Table gives a fairly detailed picture of the movements taking place. In the bottom half, the data have been aggregated into ‘small’ (less than 10 hectares), ‘medium’ (more than 10 and less than 20 hectares), and ‘large’ (more than

Table 3.2.2 Atkinson Inequality index

| Value of $\epsilon$ | 1968–69    |             |             |                      | 1969–70    |             |             |                      |
|---------------------|------------|-------------|-------------|----------------------|------------|-------------|-------------|----------------------|
|                     | Area Owned | Farm Size A | Farm Size B | Farm Business Income | Area Owned | Farm Size A | Farm Size B | Farm Business Income |
| 0.5                 | 0.1123     | 0.0989      | 0.0895      | 0.1964               | 0.1213     | 0.1026      | 0.1067      | 0.1826               |
| 1.0                 | 0.2128     | 0.1893      | 0.1746      | 0.3677               | 0.2295     | 0.1956      | 0.2058      | 0.3376               |
| 1.5                 | 0.3014     | 0.2712      | 0.2539      | 0.5335               | 0.3229     | 0.2784      | 0.2982      | 0.4706               |
| 2.0                 | 0.3785     | 0.3442      | 0.3259      | 0.7036               | 0.4013     | 0.3508      | 0.3857      | 0.5862               |
| 3.0                 | 0.5008     | 0.4626      | 0.4449      | 0.9061               | 0.5189     | 0.4651      | 0.5501      | 0.7564               |

Table 3.2.3 Changes in land ownership

| Initial Area Owned | Number of Farms where $\Delta AO > 0$ | Number of Farms where $\Delta AO < 0$ | Number of Farms where $\Delta AO = 0$ | Total $\Delta AO$ for Group |
|--------------------|---------------------------------------|---------------------------------------|---------------------------------------|-----------------------------|
| $AO \leq 15$       | 10                                    | 18                                    | 22                                    | 1.41                        |
| $5 < AO \leq 10$   | 8                                     | 5                                     | 25                                    | 10.06                       |
| $10 < AO \leq 15$  | 5                                     | 4                                     | 17                                    | 23.98                       |
| $15 < AO \leq 20$  | 1                                     | 3                                     | 12                                    | -6.55                       |
| $20 < AO \leq 25$  | 0                                     | 2                                     | 0                                     | -4.52                       |
| $25 < AO \leq 30$  | 1                                     | 1                                     | 3                                     | -29.55                      |
| $AO > 30$          | 4                                     | 3                                     | 6                                     | 0.40                        |
|                    | 29                                    | 36                                    | 85                                    | -5.57                       |
| Small              | 14                                    | 21                                    | 47                                    | 11.47                       |
| Medium             | 13                                    | 9                                     | 29                                    | 17.43                       |
| Large              | 2                                     | 6                                     | 9                                     | -33.67                      |

20 hectares). Using this classification, of the small farms, 14 increased in size and 21 decreased in size. For medium-sized farms, 13 increased and 9 decreased in size. For large farms, 2 increased and 6 decreased in size.

Thus, if we ignore the large farms, we can say that small farms have got smaller while medium-sized farms have got larger. The total (net) change (increase) in area owned for small farms was 11.47 hectares, while for medium-sized farms it was 17.43 hectares. The large farms have decreased in size. Thus the picture that emerges from this is that if we confine our attention to the lower end of the distribution there has been some increase in equality. This provides additional support to our earlier inequality index results.

Tables 3.2.4, 3.2.5, and 3.2.6 give similar distributions for Farm Size A, Farm Size B, and Farm Business Income, respectively. Table 3.2.4, using changes in Farm Size A, suggests a slightly less unequal distribution since more small farms ( $\leq 10$  hectares) grew large than grew smaller and more medium-sized farms (between 10 and 20 hectares) became smaller than grew larger. Also, more large farms decreased in size than those that increased. Table 3.2.5, for changes in Farm Size B, suggest a very similar pattern except that at the upper end there seems to have been a net gain. Table 3.2.6 for changes in Farm Business Income, suggests a greater equalisation at the lower end of the distribution.<sup>5</sup>

Having presented Tables similar to Dantwala and Rao (1974), I would like to make some cautionary remarks about the interpretations made above. A simple example illustrates the difficulty of using 'movements ... up or down the agricultural ladder' as indicating changes in distribution. Assume a community of 10 farmers, each with a farm of 5 hectares in the initial period. In the next period, we observe 9 farmers each with 6 hectares while

Table 3.2.4 Changes in Farm Size A

| Initial Farm Size A | Number of Farms where $\Delta FSA > 0$ | Number of Farms where $\Delta FSA < 0$ | Number of Farms where $\Delta FSA = 0$ | Total $\Delta FSA$ for Group |
|---------------------|----------------------------------------|----------------------------------------|----------------------------------------|------------------------------|
| $FSA \leq 5$        | 9                                      | 7                                      | 5                                      | 8.77                         |
| $5 < FSA \leq 10$   | 23                                     | 22                                     | 7                                      | 31.79                        |
| $10 < FSA \leq 15$  | 14                                     | 15                                     | 5                                      | -2.06                        |
| $15 < FSA \leq 20$  | 9                                      | 15                                     | 2                                      | -15.32                       |
| $20 < FSA \leq 25$  | 4                                      | 3                                      | 0                                      | -10.41                       |
| $25 < FSA \leq 30$  | 0                                      | 2                                      | 0                                      | -1.03                        |
| $FSA > 30$          | 3                                      | 5                                      | 0                                      | -3.26                        |
|                     | 62                                     | 69                                     | 19                                     |                              |

Table 3.2.5 Changes in farm size B

| Initial Farm Size B | Number of Farms where $FSB > 0$ | Number of Farms where $\Delta FSB < 0$ | Number of Farms where $\Delta FSB = 0$ | Total $\Delta FSB$ for Group |
|---------------------|---------------------------------|----------------------------------------|----------------------------------------|------------------------------|
| $FSB \leq 5$        | 13                              | 8                                      | 5                                      | 11.64                        |
| $5 < FSB \leq 10$   | 24                              | 23                                     | 3                                      | 17.69                        |
| $10 < FSB \leq 15$  | 18                              | 16                                     | 3                                      | 30.47                        |
| $15 < FSB \leq 20$  | 13                              | 14                                     | 0                                      | -5.74                        |
| $20 < FSB \leq 25$  | 1                               | 1                                      | 0                                      | -6.28                        |
| $25 < FSB \leq 30$  | 1                               | 0                                      | 0                                      | 11.95                        |
| $FSB > 30$          | 3                               | 4                                      | 0                                      | 21.78                        |
|                     | 73                              | 66                                     | 11                                     |                              |

Table 3.2.6 Changes in Farm Business Income

| Initial Area Owned | Number of Farms where $FBI > 0$ | Number of Farms where $\Delta FBI < 0$ | Number of Farms where $\Delta FBI = 0$ | Total $\Delta FBI$ for Group |
|--------------------|---------------------------------|----------------------------------------|----------------------------------------|------------------------------|
| $AO \leq 5$        | 18                              | 10                                     | 1                                      | 43,734.28                    |
| $5 < AO \leq 10$   | 37                              | 15                                     | 1                                      | 138,553.47                   |
| $10 < AO \leq 15$  | 21                              | 7                                      | 2                                      | 71,466.02                    |
| $15 < AO \leq 20$  | 14                              | 6                                      | 1                                      | 82,029.65                    |
| $20 < AO \leq 25$  | 4                               | 0                                      | 0                                      | 21,035.82                    |
| $25 < AO \leq 30$  | 3                               | 2                                      | 0                                      | 41,818.52                    |
| $AO > 30$          | 5                               | 3                                      | 0                                      | 77,775.55                    |
|                    | 102                             | 43                                     | 5                                      |                              |

Note: Where  $FBI = \pm 100$  it was treated as if it was zero.

the tenth farmer has only 1 hectare. This group of small farmers has had a net increase in land ( $9-4=5$  hectares). More farmers have increased their farm size (only one went down in size). Thus Dantwala and Rao would argue that the distribution was improving. However, almost any inequality index would show that inequality had increased. It is, therefore, not surprising that their analysis using inequality indexes is apparently contradicted by their movements along the agricultural ladder. They do, however, have two important points: one, that we should study the movement of *families* rather than *farms*, and second, that we should look at absolute levels at the lower end of the distribution, e.g., the families below a 'poverty-line'. Unfortunately, we do not have adequate data to take account of these points.

## Conclusions

First, let me summarise our findings. Our measures of inequality suggest that the distribution of Farm Business Income is much more unequal than the distribution of Farm Size (however measured) for 1968-69 and 1969-70. There has been a slight increase in inequality of land owned, land available for cultivation (Farm Size A), and land cultivated (Farm Size B). However, there has been a slight decrease in inequality of Farm Business Income. The latter result is difficult to explain, given the increase in inequality of the cultivated area (Farm Size B), unless it is purely due to random factors like weather. Although we have presented Tables showing movements along the agricultural ladder (*a la* Dantwala and Rao) we hesitate to place much weight on them. An interesting feature of them is the large number of changes taking place, suggesting a non-stationary agricultural sector. The limitation of our study has already been mentioned, especially in that we did not look at wages and employment, or at non-farm wealth and incomes of these farmers.

Several issues need following up. We need a more comprehensive measure of wealth to include farm and non-farm assets of 'families' and to then compare changes in distribution over time. Similarly, we should look at family incomes (including wages earned outside the family farm) rather than our restrictive 'Farm Business Income'. Finally, recent developments on the "oil front" (and its consequent impact on fertilisers) may lead to another shift in distribution. These and other issues require a *continuing* study of the *same* sample, but as yet there are only data for three years from Farm Management Studies.

I would like to conclude with a plea that in these (almost) post-Green Revolution days, government policies toward agriculture should be assessed not only in terms of their impact on production but also on distribution. Even many of the well-meaning policies to aid the smaller farmers somehow end up aiding the richer farmers.<sup>6</sup> Is the rural power structure so powerful that it can frustrate all reformist attempts at redistribution?

## Notes

1. One way around this would have been to use Atkinson's (1970) Inequality Index which has an explicit inequality aversion parameter.
2. This assumes that large farms previously left more land uncultivated. There is some evidence for this observation.
3. This may also be because the leased out land is not contiguous to their farm.
4. See Atkinson (1970).
5. Compare above (Table 2) where the Atkinson Index suggests the same finding.
6. See, for example, Desai (1974).

# 3.3

## Mobility and Inequality in Indian Agriculture

P. N. Junankar

*This paper attempts to study changes in income and wealth distribution in Indian agriculture, using Farm Management Studies data for the Ferozepur district of Punjab. The proposed method of analysis allows the author to test whether inequality is increasing or decreasing on average or whether it is changing due to mobility in the sample. Also tested are the commonly made assumption of 'time homogeneity', i e, transition probabilities remain constant over time, and whether an individual farm that does well in one period does even better in the next period.*

### Introduction

The aim of this paper is to study changes in income and wealth distribution in Indian agriculture using Farm Management Studies data from the Ferozepur district of Punjab. The paper uses a short time series of a 'cohort' of farms (not farmers) for 1967/68, 1968/69 and 1969/70. This is an especially interesting period since the Green Revolution was just beginning to gain importance in northern India. There has been much discussion about how the gains of the Green Revolution have been unfairly distributed (Byres (1972), Griffin (1974), Hanumantha Rao (1975), Junankar (1975), Das Gupta (1977)) due to the easier access large farmers have to credit and hence to high yielding varieties of seeds, fertilisers and irrigation. In this paper I shall use regression analysis to study changes in inequality over time. The proposed method of analysis allows us to test whether inequality is increasing or decreasing *on average*, or whether it is changing due to *mobility* in the sample. We can also test the commonly made assumption of 'time homogeneity' (i e, transition probabilities remain constant over time) see Shorrocks (1976). Finally, we can test whether an individual farm that does well in one

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period does even better in the next period or, in Hart's (1976) words, does 'success breed success'. Our method employs Zellner's seemingly unrelated regressions estimation technique to estimate a set of equations subject to restrictions.

The paper begins with a brief description of the data and then discusses the models to be estimated. A concluding section summarises the results and makes suggestions for further work.

## II Data

The data are from the Farm Management Studies for the Ferozepur district of Punjab (India) for the years 1967/68, 1968/69 and 1969/70. The data are for the *same* 150 farms chosen on a stratified random sample. Primary data are collected by the cost accounting method and secondary data from office records maintained by the revenue divisions and district headquarters. The sample is chosen from one of the richest Indian states where the Green Revolution has made large strides. Of the 150 farms, (in 1967/68) 111 farms had some proportion of their land under 'Mexican Wheat' (one of the high yielding varieties of wheat developed in Mexico under the guidance of Dr Borlaug). By 1969/70, all but eight farms had some land under Mexican Wheat. The proportion of land irrigated to total acreage cultivated was also very high (94 per cent in 1968/69). Self cultivation was predominant and tenancy was relatively low. Farmers leased in land to supplement their own land holdings and there were virtually no 'pure' tenants (1 in 1967/68 and 3 in 1969/70). The main crop for this region was wheat and almost all farms used hired labour (in addition to family labour) at peak seasons. The number of tractors increased from 28 in 1968/69 to 39 in 1969/70 although they were, on average, utilised for only 76 days per year on all farm work plus social and family affairs. The years 1967/68 and 1969/70 were 'normal agricultural years' but 1968/69 was hotter and had less rainfall than average.

For income distribution I used data on Farm Business Income defined as gross income *minus* all cash and kind expenses actually incurred (but *excluding* imputed values for family labour and owned land). It is important to note that this excludes all non-farm incomes from other activities (e.g., trading commodities, money lending, etc) and all landless families which would tend to make the actual income distribution more unequal than the measured distribution. On the other hand, this measure excludes labour income obtained by working on other farms, which would tend to bring up the lower tail of the income distribution. As there are no data for these types of income, it is, *a priori*, difficult to judge which way the bias may go.

For wealth distributions I shall look at the distribution of land owned which is, in a rural society, a good index of wealth and power. Because of various land ceiling laws we should be cautious about statistics on land ownership. However, since it is virtually impossible to obtain accurate information,



I shall use the data which have been collected. Since we are looking at changes over a short period of time this may not cause too much of a problem if there are no significant changes in mis-reporting. Over the period, two farmers lost their land and became pure tenants.

### III Regression Analysis

In this Section we shall analyse our longitudinal data on farms extending the methods employed by Hart (1976) and Creedy and Hart (1979). Most studies of the dynamics of income distribution have used Markov models assuming time homogeneity, see Shorrocks (1976). In addition in empirical usage, researchers have to arbitrarily define the number and width of class intervals before studying transition probabilities from one class to another. In using regression analysis we avoid the problem of defining class intervals and use each individual farm as our observation. Let me first assume that

$$\frac{Y_{it}}{\mu_t} = \alpha + \beta \frac{Y_{it-1}}{\mu_{t-1}} + u_{it} \quad (1)$$

where  $Y_{it}$  is the income or land owned by an individual  $i$  in period  $t$ .  $Y_{it}$  is normalised by its arithmetic mean to remove heteroscedasticity. The residual,  $u_{it}$ , is assumed (for the moment) to be independently identically distributed with mean zero and constant variance. Taking expectations of both sides of (1) we get

$$1 = \alpha + \beta$$

From Kakwani (1977) we have

$$G_t = \beta G_{t-1}$$

where  $G_t$  is the Gini coefficient for the distribution in period  $t$ .

In the above formulation we assume that the transition probability,  $\beta$ , is identical over individuals: there is 'population homogeneity'. Now assuming that the transition probabilities are constant over time, i.e.,  $\beta_t = \beta_{t-1}$  for all  $i$ , ('time homogeneity') gives the result that if  $\beta = 1$  then  $G_t = G_{t-1}$  and if  $\beta < 1$  we have  $G_t < G_{t-1}$ , that is inequality, on average, is declining over time. This is referred to as regression to the mean *a la* Galton. Thus we can test if  $\beta$  is significantly different from one, or equivalently whether  $\alpha + \beta = 1$  (since  $\alpha \geq 0$ ). Note, however, that even if there is no change taking place on average, there is still mobility: the smaller the correlation coefficient, the greater the mobility.

Assuming population and time homogeneity we can illustrate the case for  $\beta < 1$ .

Taking a particular value,  $Y_{ot-1}$ , his next period income is greater and continues to increase until the intersection at A. Thus if our assumption were valid, *and there was no mobility*, the distribution would collapse to a mass point (see Diagram).

Most of the income distribution literature assumes log normality: let us also assume that  $y_t$  and  $y_{t-1}$  are bivariate log normal and write

$$\ln Y_{it} = \alpha + \beta \ln Y_{it-1} + u_{it} \quad (2)$$

say

$$Y_{it} = \alpha + \beta Y_{it-1} + u_{it} \quad (3)$$

taking expectations of both sides

$$\mu_t = \alpha + \beta \mu_{t-1} \quad (4)$$

subtracting (4) from (3) we get

$$Y_{it} - \mu_t = \beta(Y_{it} - \mu_{t-1}) + u_{it} \quad (5)$$

and rewriting as

$$Z_{it} = \beta Z_{it-1} + u_{it} \quad (6)$$

we can test for  $\beta = 1$ .

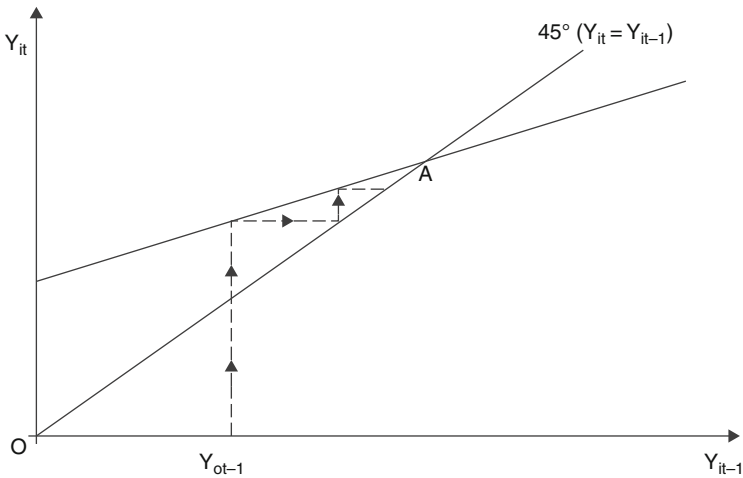


Figure 3.3.1 Diagram 1

It is common to use the standard deviation of logs as an index of inequality even though it does not satisfy the Pigou-Dalton conditions. Hart (1979) argues that this violation does not usually occur in practice (also see Sen (1973)). Taking variances of (6)

$$\sigma_t^2 = \beta^2 \sigma_{t-1}^2 + \sigma_u^2 \quad (7)$$

For  $\beta > 1$  inequality (as measured by  $\sigma$ ) increases over time. For  $\beta < 1$ , inequality *on average* decreases over time. However, even if  $\beta < 1$  inequality can increase due to  $\sigma_u^2$  being large, i.e., due to mobility. Hart (1976) shows that since

$$r^2 = 1 - \sigma_u^2 / \sigma_t^2$$

rewriting

$$\sigma_t^2 / \sigma_{t-1}^2 = \beta^2 / r^2$$

hence inequality increases if  $|\beta| > |r|$ . Thus the lower is  $r$  the higher is  $\sigma_u^2$  and hence mobility increases inequality.

Now assume that the transition probabilities are not constant over time (no 'time homogeneity') and an individual who does well in one period does even better (or less well) in the next period. This can be formalised in terms of the errors,  $u_{it}$ , being correlated with past errors,  $u_{it-1}$ . We can thus study changes in inequality due to 'average' behaviour and the serial correlation effect. Formally, rewriting (6) as

$$Z_{it} = \beta_1 Z_{it-1} + u_{it} \quad (7)$$

$$\text{and } Z_{it-1} = \beta_2 Z_{it-2} + u_{it-1} \quad (8)$$

$$\text{where } u_{it} = \rho u_{it-1} + \varepsilon_{it}, \rho \geq 0 \quad (9)$$

Combining (7), (8) and (9) we get

$$Z_{it} = (\beta_1 + \rho) Z_{it-1} - \beta_2 \rho Z_{it-2} + \varepsilon_{it} \quad (10)$$

There are certain estimation problems involved and three alternatives exist. Firstly, to estimate equations (7) and (8) separately and then regress the residuals from equation (7) on the residuals from equation (8). This gives an estimate of  $\rho$ . Estimating equation (10) by ordinary least squares, we can get estimates of  $\beta_1$ , and  $\beta_2$  by using the estimate of  $\rho$  obtained by regressing the residuals. This, however, does not give consistent estimates of  $\beta_1$  and  $\beta_2$ . The second method is to estimate equation (10) by ordinary least squares,

and assuming  $\beta_1 = \beta_2 = \beta$ , we can solve a quadratic to find estimates of  $\beta$  and  $\rho$ . These methods are discussed in Hart (1976) and Creedy and Hart (1979). The third, and in my opinion correct, method is to estimate equations (7) and (8) *jointly* using Zellner's Seemingly Unrelated Estimation which exploits the non-zero covariance between  $u_t$  and  $u_{t-1}$  to give asymptotically efficient results. In this formulation we can test for the equality of the  $\beta$ s (the assumption of time homogeneity) and we can simultaneously get an estimate of  $\rho$  from the variance-covariance matrix of residuals.

Now let us turn to the results. Table 3.3.1 presents results for area owned normalised by the mean; that is estimates of equation 1.

From Table 3.3.1 we can see that since we cannot reject the restriction  $\alpha + \beta = 1$ , it implies that inequality was unchanging. However, since  $R^2$ s are 0.84 and 0.78 respectively, there is increasing mobility in the sample.

Let us now turn to estimation of equations (6) through (10) by Ordinary Least Squares and then estimation of equations (7) and (8) by Zellner's Seemingly Unrelated Regressions method. These results are presented in Tables 3.3.2, 3.3.3, 3.3.4 and 3.3.5.

In Tables 3.3.2 and 3.3.4 in the first three estimated equations results are presented assuming no serial correlation. In Table 3.3.2 we find that for log deviations of area owned there is a fair bit of mobility. From 1967/68 to 1968/69,  $\beta$  is significantly less than 1 implying on average that inequality is decreasing. Note that  $\beta < r$ , hence this also suggests decreasing inequality. From 1968/69 to 1969/70,  $\beta$  is not significantly different from 1 but is greater than  $r$ , suggesting *increasing* inequality as measured by the standard deviation of logs. Here it is *mobility* that is leading to an increase in inequality. Taking the period 1967/68 to 1969/70 we find  $\beta$  is significantly different from one suggesting decreasing inequality. Also

Table 3.3.1 Regression results: area owned normalised by mean

|                                                            |                                                                        |  |                                                               |
|------------------------------------------------------------|------------------------------------------------------------------------|--|---------------------------------------------------------------|
| OLS Estimates                                              |                                                                        |  |                                                               |
| 1 NORMAO69=                                                | 0.042+0.964 NORMAO68<br>(0.943) (27.838)<br>$\bar{R}^2=0.841$<br>n=147 |  | s e ( $\hat{\alpha}$ )=0.044<br>s e ( $\hat{\beta}$ )=0.0346  |
| Test of $\alpha + \beta = 1$ : Not Reject [F(1,145)=0.037] |                                                                        |  |                                                               |
| 2 NORMAO68=                                                | 0.019+0.892 NORMAO67<br>(2.190) (22.662)<br>$\bar{R}^2=0.778$<br>n=147 |  | s e ( $\hat{\alpha}$ )=0.0499<br>s e ( $\hat{\beta}$ )=0.0394 |
| Test of $\alpha + \beta = 1$ : Not Reject [F(1,145)=0.003] |                                                                        |  |                                                               |

Notes: 1 AO=Area Owned.

2 NORMAO69=AO69/Mean (AO69) etc.

Table 3.3.2 Regression results: log deviations of area owned

|                                     |                        |       |
|-------------------------------------|------------------------|-------|
| OLS Estimates                       |                        |       |
| 1 LDEVAO69=0.957 LDEVAO68           |                        |       |
| (0.044)                             |                        |       |
| $R^2=0.768$                         |                        | n=147 |
| $\hat{\beta} > R$                   |                        |       |
| 2 LDEVAO68=0.833 LDEVAO67           |                        |       |
| (0.042)                             |                        |       |
| $R^2=0.727$                         |                        | n=147 |
| $\hat{\beta} < R$                   |                        |       |
| 3 LDEVAO69=0.876 LDEVAO67           |                        |       |
| (0.051)                             |                        |       |
| $R^2=0.674$                         |                        | n=147 |
| $\hat{\beta} > R$                   |                        |       |
| 4 LDEVAO69=0.706 LDEVAO68           |                        |       |
| (0.080)                             |                        |       |
|                                     | +0.288 LDEVAO67        |       |
|                                     | (0.078)                |       |
| $R^2=0.788$                         |                        | n=147 |
| $\hat{\beta}=0.995$                 | $\hat{\varrho}=-0.289$ |       |
| (Solution to Quadratic Equation)    |                        |       |
| 5 RESIDUALS 69= -0.251 RESIDUALS 68 |                        |       |
| (0.080)                             |                        |       |
| $R^2=0.062$                         |                        | n=147 |

Notes: 1 AO=Area Owned.  
2 LDEVAO=Log AO – Mean (Log AO).  
3 Parentheses contain standard errors.  
4  $R=\sqrt{R^2}$ .

Table 3.3.3 Regression results: log deviations of area owned – Zellner's Seemingly Unrelated Regression Estimation

|                                                                               |  |
|-------------------------------------------------------------------------------|--|
| (a) Unrestricted                                                              |  |
| 1 LDEVAO69=1.052 LDEVAO68                                                     |  |
| (0.052)                                                                       |  |
| 2 LDEVAO68=0.833 LDEVAO67                                                     |  |
| (0.042)                                                                       |  |
| $\hat{\varrho}$ estimated from Variance-Covariance Matrix of Residuals=-0.346 |  |
| (b) Restricted                                                                |  |
| 1 LDEVAO69=0.927 LDEVAO68                                                     |  |
| (0.029)                                                                       |  |
| 2 LDEVAO68=0.927 LDEVAO68                                                     |  |
| (0.029)                                                                       |  |
| Test of Restriction ( $\beta_1=\beta_2$ )                                     |  |
| $\chi^2=8.91$                                                                 |  |
| Critical $\chi^2_{.05}=3.84$                                                  |  |
| Reject $H_0: \beta_1=\beta_2$                                                 |  |

Table 3.3.4 Regression results: log deviations of FBI

---

|                                    |                        |       |
|------------------------------------|------------------------|-------|
| OLS Estimates                      |                        |       |
| 1 LDEVFBI69=0.685 LDEVFBI68        |                        |       |
|                                    | (0.050)                |       |
| $R^2=0.565$                        |                        | n=144 |
| $\hat{\beta} \leq R$               |                        |       |
| 2 LDEVFBI68=0.810 LDEVFBI67        |                        |       |
|                                    | (0.068)                |       |
| $R^2=0.501$                        |                        | n=144 |
| $\hat{\beta} > R$                  |                        |       |
| 3 LDEVFBI69=0.758 LDEVFBI67        |                        |       |
|                                    | (0.060)                |       |
| $R^2=0.528$                        |                        | n=144 |
| $\hat{\beta} > R$                  |                        |       |
| 4 LDEVFBI69=0.433 LDEVFBI68        |                        |       |
|                                    | (0.065)                |       |
|                                    | +0.407 LDEVFBI67       |       |
| $R^2=0.641$                        | (0.074)                | n=144 |
| $\hat{\beta}=0.890$                | $\hat{\varrho}=-0.457$ |       |
| (Solution to Quadratic Equation)   |                        |       |
| 5 RESIDUALS 69=-0.252 RESIDUALS 68 |                        |       |
|                                    | (0.068)                |       |
| $R^2=0.088$                        |                        | n=144 |

---

Notes: FBI = Farm Business Income.  
LDEVFBI = Log FBI – Mean (Log FBI).  
Parentheses contain standard errors.  
 $R=\sqrt{R^2}$ .

Table 3.3.5 Regression results: log deviations of FBI – Zellner's Seemingly Unrelated Estimation

---

|                                                            |         |
|------------------------------------------------------------|---------|
| (a) Unrestricted                                           |         |
| 1 LDEVFBI69=0.936 LDEVFBI68                                |         |
|                                                            | (0.077) |
| 2 LDEVFBI68=0.810 LDEVFBI67                                |         |
|                                                            | (0.068) |
| (b) Restricted=( $\beta_1=\beta_2$ )                       |         |
| 1 LDEVFBI69=0.869 LDEVFBI68                                |         |
|                                                            | (0.036) |
| 2 LDEVFBI68=0.869 LDEVFBI67                                |         |
|                                                            | (0.036) |
| Test of Restriction ( $\beta_1=\beta_2$ ): $\chi^2 = 1.07$ |         |
| Critical $\chi^2_{.05} = 3.84$                             |         |
| Cannot Reject $H_0$ : $\beta_1=\beta_2$                    |         |
| $\hat{\varrho}$ estimated from Variance-Covariance         |         |
| Matrix of Residuals=-0.439                                 |         |

---

$\beta > 1$  confirming that *mobility* is leading to an increase in inequality. In Table 3.3.4, the corresponding results for log deviations of Farm Business Income, we find that  $\beta$  is significantly less than one, suggesting a decrease in inequality over both periods. However, mobility increases inequality from 1967/68 to 1968/69. From 1968/69 to 1969/70 the results suggest a decrease in inequality. Over the period 1967/68 to 1969/70 mobility leads to an increase in inequality.

Let us now turn to the results when we allow for serial correlation, that is estimates for equation 7 through 10. These are presented in the estimated equations 4 and 5 of Tables 3.3.2 and 3.3.4 (the Hart-Creedy method) and in Tables 3.3.3 and 3.3.5 (the Zellner method proposed by us). The Hart-Creedy quadratic method for Area Owned (Table 3.3.3) gives  $\hat{\beta} = 0.995$  and  $\hat{\varrho} = -0.289$  (assuming  $\beta_1 = \beta_2 = \beta$  and  $\beta > \varrho$ ). For FBI the same method gives  $\hat{\beta} = 0.890$  and  $\hat{\varrho} = -0.457$ . Note that in both cases there is *negative* serial correlation: success does not breed success. This is a slightly surprising and unexpected result. Whether this would hold if we allowed for population heterogeneity and/or extended the cohort study to a longer time period is open to speculation. The Hart-Creedy residuals method which allows  $\beta_1 \neq \beta_2$  also gives us estimates of  $\hat{\varrho}$  which are negative. Although no tests of significance were carried out, the two estimates of  $\varrho$  for Area Owned are surprisingly similar but are apparently different for FBI. A resolution of those apparently contradictory results may be seen in the results using Zellner's estimation method (Tables 3.3.3 and 3.3.5). For Area Owned we reject the assumption of time homogeneity and obtain an estimate of  $\varrho (\hat{\varrho} = \hat{\sigma}_{tt-1} / \hat{\sigma}_{t-1}^2)$ . The equations are estimated with and without restrictions and a log-likelihood test (which is distributed as a chi-square) rejects the restriction. There is clear evidence of negative serial correlation ( $\hat{\varrho} = -0.346$ ). The estimates of  $\beta_1$ , and  $\beta_2$  suggest that *on average*, inequality decreased from 1967/68 to 1968/69 ( $\beta < 1$ ) and there was no change from 1968/69 to 1969/70 ( $\beta = 1$ ). As discussed earlier, it is *mobility* that leads to increased inequality between 1968/69 and 1969/70.

For Farm Business Income (Table 3.3.5) we cannot reject the assumption of time homogeneity and we still find negative serial correlation with  $\hat{\varrho} = -0.439$ . A casual comparison suggests that the quadratic method gives very similar results because the assumption of time homogeneity is not rejected.

Thus Zellner's estimation method has provided us with a simple formal test of the assumption of time homogeneity which exploits the serial correlation that exists. At the same time it gives a consistent estimate of the serial correlation parameter.

To summarise this section: we find that, *on average*, inequality would decrease were it not for *mobility*. Mobility has led to slight increases in inequality. The rather high degree of serial negative correlation requires further study.

## IV Conclusions

In this paper we presented results on mobility and inequality using the Hart-Creedy method and then our proposed method using Zellner's Seemingly Unrelated Estimation technique. We found a small increase in inequality which was due to mobility in the sample. Using the Zellner method, we were able to test the assumption of time homogeneity. We found that for area owned we rejected the assumption of time homogeneity but for FBI we could not reject the restriction of equality of transition probabilities. The results suggest a rather high *negative* serial correlation implying that success does *not* breed success: those who are successful in one period are less successful in the next. As mentioned earlier this is one aspect of our results that requires further investigation.

Although we have a rather small sample for a cohort study we have been able to investigate the interaction of mobility and inequality. The method we proposed has general application for cohort (longitudinal) studies. The method is especially useful in being able to test a commonly made assumption of time homogeneity as well as obtaining consistent estimates of the serial correlation coefficient.

## References

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**4**

## **Do Farmers in Developing Countries Maximise Profits?**

# 4.1

## Tests of the Profit-Maximisation Hypothesis: A Study of Indian Agriculture

P. N. Junankar

*The paper presents econometric tests of a neoclassical competitive profit function model using Farm Management Studies data from the Ferozepur district of Punjab (India) for 1969/70. The aim of the paper is twofold: firstly, to test for differences in production and market behaviour of small (tenant) and large (owner) farms, and secondly, to test the validity of competitive profit-maximising models for the agricultural sector of a less developed country. The model is estimated by Zellner's 'Seemingly Unrelated Regressions' method with restrictions within and across equations. Our results suggest that the neoclassical model works very poorly and that we need to explore alternative avenues of research.*

### I Introduction

The aim of this paper is to compare the behaviour of small and large farms, and tenant and owner farms, using a 'Restricted Profit Function' approach. I shall use econometric techniques to test whether different groups of farmers maximise profits to the same extent and whether there are any differences in their technical efficiency. The data used are from the Farm Management Studies for the Ferozepur district of Punjab for 1969/70. In this section I shall outline some of the arguments that have been put forward to suggest that different groups of farmers behave differently and/or do not face the same technological constraints. In Section II, I shall outline the restricted profit function approach and distinguish between technical, price and economic efficiency. Section III is a discussion of the data being used in this paper and some conceptual problems of measurement. In Section IV I present the econometric results and discuss the limitations of the restricted profit function approach. Finally, Section V concludes the paper with some

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remarks on the appropriateness of a competitive profit-maximising model as applied to the agricultural sector of a less developed country such as India.

For some time, Indian economists (and economists concerned about India) have argued about the appropriate agricultural policy for post-independence India. Several land reforms have been passed (although not always implemented!) which have placed a ceiling on agricultural holdings and some restrictions on the conditions of leasing land. The main objective of these reforms has been egalitarian, and economists have tried to assess their likely impact on efficiency. Some of the literature that emerged after the publication of the first round of Farm Management Studies Reports suggested that small farms were relatively more productive per hectare than large farms. Schultz [1964], in a now classic work, argued that peasant farmers were 'poor but efficient'.<sup>1</sup>

It has been argued that small farms have a different production function from large farms either because of differential access to information (techniques) or because of differences in managerial efficiency. Even where they have the same production function their market behaviour is different since small farms are family farms producing mainly for subsistence while large farms are 'capitalist farms' producing mainly for the market. Small farms are less dependent on the market for their inputs, relying to a greater extent on family labour (for example) and probably concerned about maximising output rather than profits.<sup>2</sup> As for tenants, it could be argued that they are also on a different production function for reasons similar to those of small farmers. Due to insecurity of tenure, tenants may not make use of land-improving practices and hence may be on an inferior production function than owners. It has been argued that share-cropping tenants are 'inefficient' as they equate the marginal product of an input to the price of the input divided by their rental share.<sup>3</sup>

Firstly, I would like to test to see whether there are significant differences between tenants and owners, and between small and large farms. Secondly, I would like to see whether we can use a competitive profit-maximising model to explain the behaviour of farmers in poor countries.<sup>4</sup> To anticipate the results: I find that the restricted profit function approach works very poorly, throwing some doubt on a simple profit-maximising model.

## II The restricted profit function approach

In this section we follow the Lau-Yotopoulos approach [1971, 1973], assuming certainty and competitive input and output markets. We assume a Cobb-Douglas production function:

$$Y^i = A^i L^{\gamma^1} H^{\gamma^2} K^{\gamma^3} \quad (1)$$

where  $Y^i$  is the output of the  $i$ th type of farm (e.g. small/large, or tenant/owner).  $A^i$  is a neutral shift parameter which *may* vary for different types

of farms. If  $A^i > A^j$  then farms of type  $i$  are technically more efficient than farms of type  $j$ . (This is analogous to Hicks' neutral technical change. Generalisations to non-neutral differences cause estimation problems.) The production function displays diminishing marginal productivity in labour ( $H$ ) and has fixed inputs land ( $L$ ), and capital ( $K$ ). Defining variable real profits ( $\pi$ ) as total revenue less variable costs divided by output price, we can write the profit function in terms of the exogenous variables: real wage rates and fixed inputs, land and capital. The implied labour demand function (derived by differentiating the profit function) is a function of the same variables. We now allow different farm types to have differing degrees of price efficiency: if farms equate marginal physical products of labour ( $MPP$ ) to real wage rates they are price efficient.

Let

$$MPP = k^i w$$

where  $w$  is the real wage rate and  $k^i$  is a (non-negative) parameter. For example, if  $k^i = 1$  and  $k^j < 1$ , then  $i$ -type farms are price efficient and  $j$ -type farms are using 'too much' labour. This may be because they are bad at profit-maximising or that they consistently underestimate wage rates. If farms have  $A^i = A^j$  and all the  $k^i$ s are equal to one, then farms are economically efficient. The estimating equations may be written as:<sup>5</sup>

$$\ln \pi = \text{Constant} + \delta \text{ LARGE SIZEDUM} + \text{Tenancy Proxy} + \beta_1 \ln(\text{real wage}) + \beta_2 \ln \text{land} + \beta_3 \ln \text{Capital} + u_1 \quad (2)$$

$$-\frac{wL}{\pi} = \alpha_1 \text{ LARGE SIZEDUM} + \alpha_2 \text{ SMALLDUM} + \alpha_3 \text{ Tenancy Proxy} + u_2 \quad (3)$$

where the Size Dummies and the Tenancy Proxy in equation (2) are to capture differences in technical *and/or* price efficiency. In equation (3) the Size Dummies and Tenancy Proxy are to allow for difference in *price efficiency alone*. The Tenancy Proxy is defined as proportion of land leased in. The  $u_i$ s are error terms assumed to have the usual 'nice' properties, although we allow for a non-zero covariance between  $u_1$  and  $u_2$ . Note that equations (2) and (3) are a set of simultaneous equations derived from a profit-maximising model. We can estimate this model jointly using Zellner's 'Seemingly Unrelated Regressions' method which gives us asymptotically efficient results. Note that all the right-hand side variables are (by assumption) exogenous variables. We thus avoid simultaneous equation bias. Also, as we see in Section IV, this method allows us to distinguish and test for differences between farms due to reasons of technical and/or price efficiency.

### III The data and some conceptual problems of measurement

The data for this study come from the Farm Management Studies for the Ferozepur district of Punjab for the year 1969/70 (which was a normal agricultural year).<sup>6</sup> This is a fairly rich and progressive farming district and is therefore an ideal sample for our study. The data were collected on a multi-stage stratified random basis from 15 villages, with 10 'operational holdings' (farms) from each village. Primary data were collected on a cost-accounting method and secondary data were collected from the office records maintained by the revenue divisions and district headquarters. Of this sample of 150 farms, I studied only those farms that grew the new high yielding varieties of wheat (Mexican wheat) so that my sample consists of 142 farms. The sample is therefore for a homogeneous output which was the dominant crop cultivated in the *rabi* (winter) season. In that season (*rabi*, 1969/70) 64 percent of the cultivated area was under Mexican wheat and only 8 percent under *desi* (traditional) wheat. The land was well irrigated: 92 percent of the gross cropped area was irrigated and there were no significant differences in the proportion of area irrigated for different farm sizes.<sup>7</sup> The average (arithmetic mean) farm size devoted to Mexican wheat was 5.7 hectares, with a standard deviation of 5.1 hectares. Table 4.1.1 gives a frequency distribution of the farm size.<sup>8</sup>

Of the 142 farms, 40 were leasing-in some land with a mean size of leased-in land of 2.40 hectares. Of the sample all but 7 were gross hirers in labour, and only 3 did not use family labour. For reasons of data inconsistencies, 5 farms had to be deleted from my sample.

I shall now outline some of the problems in measuring some of the key variables and state the approach followed. In general, I have used a few alternative definitions for the key variables.

#### (a) Definition of Profit

Although the study only includes the farms growing Mexican wheat, there is a byproduct (fodder) which is produced along with the wheat.<sup>9</sup> If the

Table 4.1.1 Frequency distribution of farm size (Totland)

| Farm size<br>(hectares) | Absolute<br>frequency | Relative frequency<br>% |
|-------------------------|-----------------------|-------------------------|
| 0.01–4.99               | 88                    | 62.0                    |
| 5.00–9.99               | 29                    | 20.4                    |
| 10.00–14.99             | 16                    | 11.3                    |
| ≥15                     | 9                     | 6.3                     |
| Total                   | 142                   | 100.0                   |

Mean=5.66 hectares; standard deviation=5.15 hectares: median=4.04 hectares; and tange=27.47 hectares.

byproduct is produced in fixed proportions with the main product, no misspecification is involved in taking the total value of the output (main product and byproduct) and using the price of the main product as our deflator. With this assumption of fixed proportions I obtained one set of dependent variables (see below on definition of variable costs). An alternative procedure was to assume that the fanner ignored the byproduct in his optimising behaviour (in effect, treating any revenue from the byproduct as a windfall gain). Under this assumption I obtained another set of dependent variables based on the value of the main product only.

Another complicating feature is *what* variable costs to subtract from total revenue. In fact there are several variable inputs, but in the model only one variable input (labour) is allowed for, partly because of the non-availability of variable input prices and partly to simplify the model. Specifically, we had to ignore fertilisers as a variable input as we did not have farm-specific fertiliser prices. These prices are likely to vary systematically with farm size: the rich (large farmers) buying at lower prices! In the agricultural sector of a less developed country family labour plays an important role. It is thus possible to subtract from total revenue (however defined) the value of hired labour and the imputed value of family labour. An alternative is to ignore family labour on the grounds that farmers in less developed countries have not heard of the concept of opportunity costs!

We now have four definitions of profit: (1) total revenue (including byproduct) less the value of labour (including family labour); (2) total revenue (including byproduct) less the value of hired labour; (3) value of the main product less the value of labour (including family labour); and (4) value of the main product less the value of hired labour.

### **(b) Definition of the Wage Rate**

As mentioned above, most (but not all) farms used-hired labour, and the available data allow me to obtain the wage rate for hired labour. However, this requires truncating the sample by deleting those farms that do not use hired labour. An alternative is to use an average wage derived from the value of hired and family labour. (The data for the value of family labour assume an implicit wage equal to the wage paid to annual (permanent) servants.) It is also possible to obtain a wage rate for annual servants and another one for casual hired labour, but this also means truncating my sample.

### **(c) Definition of Land**

In this study I have simply used the net sown area as my 'land' variable. In other words, *no* attempt has been made to allow for differences in the fertility of the soil. In any case, other than getting some objective soil analysis from each plot (and there are many plots per farm) no reasonable alternative is available.

**(d) Definition of Capital**

Without entering the controversy between Cambridge (Massachusetts) and Cambridge (England), we need to determine some measure of capital for the production function, and via that for the profit function. (Note that since this is *not* an aggregate production function some of the aggregation problems need not worry us here.) For a production function we need a 'physical' measure of capital, ideally the flow of services from physical capital. A fairly common approach is to use the implicit (or actual) interest costs on capital, plus the depreciation costs, plus any costs of hiring equipment, repair costs, etc. This gives one definition of capital. A broader definition is to include the value of farmyard manures and fertilisers which are extremely important for high yielding varieties of seeds.<sup>10</sup> An even broader definition is to include the imputed value (or hire charges) of bullock labour which, in spite of some mechanisation, is an important part of Indian agriculture. Note that most farmers own their bullocks and maintenance costs are *fixed* costs independent of utilisation.

**(e) List of Variables<sup>11</sup>**

$$\text{LREALMP1} \equiv \ln \left( \frac{\text{Value of main product} - \text{Value of hired labour}}{\text{Price of main product}} \right)$$

$$\text{LREALMP2} \equiv \ln \left( \frac{\text{Value of main product} - \text{Value of hired and family labour}}{\text{Price of main product}} \right)$$

$$\text{LREALTP1} \equiv \ln \left( \frac{\text{Value of main product and byproduct} - \text{Value of hired labour}}{\text{Price of main product}} \right)$$

$$\text{LREALTP2} \equiv \ln \left( \frac{\text{Value of main product and byproduct} - \text{Value of hired and family labour}}{\text{Price of main product}} \right)$$

(Note that a variable name beginning with 'L' refers to its being a natural logarithm).

$$\text{DEPV1} \equiv \frac{\text{Value of hired labour}}{(\text{Value of main product} - \text{Value of hired labour})}$$

$$\text{DEPV2} \equiv - \frac{\text{Value of hired and family labour}}{(\text{Value of main product} - \text{Value of hired and family labour})}$$

$$\text{DEPV3} \equiv - \frac{\text{Value of hired labour}}{(\text{Value of main product and byproduct} - \text{Value of hired labour})}$$



$$\text{DEPV4} \equiv - \frac{\text{Value of hired and family labour}}{(\text{Value of main product and byproduct} - \text{Value of hired and family labour})}$$

$$\begin{aligned} \text{LARGE SIZEDUM} &= 0 \text{ if TOTLAND} \leq 5 \text{ hectares} \\ &= 1 \text{ if TOTLAND} > 5 \text{ hectares} \end{aligned}$$

$$\begin{aligned} \text{SMALLDUM} &= 0 \text{ if TOTLAND} > 5 \text{ hectares} \\ &= 1 \text{ if TOTLAND} \leq 5 \text{ hectares} \end{aligned}$$

$$\text{Tenancy Proxy} = \frac{\text{Area leased in}}{\text{TOTLAND}}$$

$$\text{TOTLAND} \equiv \text{Area owned} + \text{Area leased in} - \text{Area leased out}$$

$$\text{LREAWAGE} \equiv \frac{\text{Value of hired and family labour}}{\text{Hour worked by hired and family labour}} \div \text{Price of main product}$$

$$\begin{aligned} \text{CAPITAL} \equiv & (\text{Depreciation of implements plus depreciation of farm buildings} \\ & \text{minus hire charges received}) \\ & + (\text{Interest on fixed capital including implements}) \\ & + (\text{Interest on working capital}) \\ & + (\text{Depreciation on irrigation equipment minus income from} \\ & \text{hiring-out plus working expenditure of owned equipment plus} \\ & \text{charges of hired equipment}) \\ & + [(\text{Running expenditure of farm machinery (excluding irriga-} \\ & \text{tion equipment) and its depreciation minus income received} \\ & \text{from hiring-out owned machinery})] \end{aligned}$$

$$\text{LOGCAP} \equiv \ln (\text{CAPITAL})$$

$$\text{CAPFER} \equiv \text{CAPITAL} + (\text{Value of manures} + \text{fertilisers})$$

$$\text{LCAPFER} \equiv \ln (\text{CAPFER})$$

$$\text{KAPITAL} \equiv \text{CAPFER} + \text{Value of bullock labour services (hired and owned)}$$

$$\text{LKAPITAL} \equiv \ln (\text{KAPITAL})$$

## IV Some econometric results

In this section I shall present the results of testing the restricted profit function model as set out in Section II. As mentioned in the previous section there are alternative definitions of the dependent variable as well as of some of the independent variables, and we can test the model to see if there are any significant differences in the general results we obtain. First, I shall present results using different definitions of the dependent variable but

the same set of independent variables. The model is given by equations (2) and (3) and is jointly estimated by Zellner's seemingly unrelated regression method *without* restrictions on the parameters. These results, using a broad definition of capital which includes the value of fertilisers and manures as well as the value of bullock labour (LKAPITAL) and an average real wage (hired and family, LREAWAGE), are presented in Table 4.1.2.

The parameter estimates for land and capital have the correct sign, are of 'reasonable' magnitude, and are well defined (they have small asymptotic standard errors) for all definitions of the dependent variable.<sup>12</sup> The parameter estimate for the real wage term, however, always has the wrong sign and fairly small asymptotic standard errors but is not significantly different from zero. The Large Size Dummy and the Tenancy Proxy in the profit equation are always insignificant. In the labour demand equations the Size Dummies are significant in all cases while Tenancy Proxy is significant for only DEPV1 and DEPV3.

These results are hardly encouraging to a good neoclassical economist, since the wage variable consistently comes out with the wrong sign.<sup>13</sup> It

Table 4.1.2 Mexican wheat profit functions (1969/70): Zellner's Seemingly Unrelated Estimation (Unconstrained)

|            | LREALMP1          | LREALMP2          | LREALTP1          | LREALTP2          |
|------------|-------------------|-------------------|-------------------|-------------------|
| Constant   | 0.914<br>(0.709)  | 0.708<br>(0.713)  | 1.019<br>(0.712)  | 0.929<br>(0.696)  |
| $\delta$   | -0.058<br>(0.082) | 0.079<br>(0.091)  | -0.074<br>(0.082) | 0.045<br>(0.089)  |
| $\gamma$   | 0.099<br>(0.132)  | -0.008<br>(0.159) | 0.094<br>(0.130)  | -0.001<br>(0.156) |
| $\beta_1$  | 0.140<br>(0.100)  | 0.121<br>(0.100)  | 0.134<br>(0.098)  | 0.134<br>(0.098)  |
| $\beta_2$  | 0.681<br>(0.078)  | 0.641<br>(0.078)  | 0.682<br>(0.078)  | 0.644<br>(0.076)  |
| $\beta_3$  | 0.411<br>(0.074)  | 0.405<br>(0.074)  | 0.404<br>(0.074)  | 0.398<br>(0.072)  |
|            | DEPV1             | DEPV2             | DEPV3             | DEPV4             |
| $\alpha_1$ | -0.178<br>(0.021) | -0.344<br>(0.043) | -0.167<br>(0.019) | -0.321<br>(0.037) |
| $\alpha_2$ | -0.159<br>(0.017) | -0.428<br>(0.034) | -0.142<br>(0.015) | -0.378<br>(0.029) |
| $\alpha_3$ | 0.107<br>(0.057)  | -0.019<br>(0.116) | 0.096<br>(0.051)  | -0.010<br>(0.100) |

Equation 1:  $\log \pi = C + \delta \text{ LARGE SIZEDUM} + \gamma \text{ TENANCY PROXY} + \beta_1 \text{ LREAWAGE} + \beta_2 \text{ LTOTLAND} + \beta_3 \text{ LKAPITAL} + u_1$

Equation 2:  $\text{DEPV}(i) = \alpha_1 \text{ LARGE SIZEDUM} + \alpha_2 \text{ SMALLDUM} + \alpha_3 \text{ TENANCY PROXY} + u_2$

Notes: Parentheses contain asymptotic standard errors.  $n=137$ .

suggests that the model is misspecified and hence we should not put too much emphasis on the other parameter estimates in the model. The object of presenting these results with alternative definitions of the dependent variable was to avoid the charge of choosing the least favourable definitions for the restricted profit function model. The next stage I followed was to use alternative definitions of capital and to estimate the model subject to restrictions on the parameters, to see whether there were significant differences in technical, price and economic efficiency between small and large farmers, and between owners and tenant farmers.

As discussed in Section II, the profit function could differ for small and large farms (or owner and tenant farms) because of differences in technical efficiency and/or because of differences in price efficiency. The labour demand function, on the other hand, differs *only* because of differences in price efficiency.<sup>14</sup> We can therefore test for:

*Equal Economic Efficiency*

- (i)  $\delta=0$  (small/large farms)
- (ii)  $\delta=\text{and } \gamma=0$  (small/large and owner/tenant farms)

*Equal Relative Price Efficiency*

- (iii)  $\alpha_1=\alpha_2$  (small/large farms)
- (iv)  $\alpha_1=\alpha_2$  and  $\alpha_3=0$  (small/large and owner/tenant farms)

*Equal Relative Technical and Price Efficiency*

- (v)  $\delta=0$  and  $\alpha_1=\alpha_2$  (small/large farms)
- (vi)  $\delta=\gamma=0$  and  $\alpha_1=\alpha_2$  and  $\alpha_3=0$  (small/large and owner/tenant farms)

*Absolute Price Efficiency ( $k^i=1$ )*

- (vii)  $\alpha_1=\alpha_2$  and  $\alpha_1=\beta_1$  (large farms)
- (viii)  $\alpha_1=\alpha_2$  and  $\alpha_2=\beta_1$  (small farms)

*Constant Returns to Scale (in all inputs)*

- (ix)  $\beta_2+\beta_3=1$

For the purposes of testing the model subject to the restrictions discussed above, I used LREALTP2 as the dependent variable. This, assuming a fixed proportion of byproduct to the main product, seems a 'reasonable' dependent variable for a profit-maximising farmer.<sup>15</sup> The model was estimated with the three alternative definitions of capital discussed in Section III. The results are presented in Tables 4.1.3, 4.1.4 and 4.1.5.

As we saw with alternative definitions of the dependent variable, the real wage coefficient *always* has the wrong sign and is often significant. This is so whether it is estimated with or without constraints. The only exception is where it is estimated subject to the restrictions  $\alpha_1=\beta_1$  and  $\alpha_1=\alpha_2$  when it turns up with a negative sign *but an F-test rejects these restrictions*.<sup>16</sup> The land variable always has a correct sign, is significant, and is of a 'plausible' magnitude. It is interesting to compare the behaviour of the model for alternative

Table 4.1.3 Mexican wheat profit functions (1969/70)

| Number | Estimation method | Restrictions                                              | F value for restrictions | Constant          | $\delta$          | $\gamma$          | $\beta_1$         | $\beta_2$        | $\beta_3$        | $\alpha_1$        | $\alpha_2$        | $\alpha_3$        |
|--------|-------------------|-----------------------------------------------------------|--------------------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|-------------------|
| 1.     | OLS               | none                                                      | -                        | -0.583<br>(0.987) | -0.069<br>(0.106) | 0.014<br>(0.156)  | -0.117<br>(0.139) | 0.702<br>(0.109) | 0.437<br>(0.103) | -0.323<br>(0.037) | -0.391<br>(0.030) | 0.003<br>(0.096)  |
| 2.     | Zellner           | none                                                      | -                        | 0.929<br>(0.696)  | 0.045<br>(0.089)  | -0.001<br>(0.156) | 0.134<br>(0.098)  | 0.644<br>(0.072) | 0.398<br>(0.072) | -0.321<br>(0.037) | -0.378<br>(0.029) | -0.010<br>(0.099) |
| 3.     | Zellner           | $\delta=0$                                                | $F(1,265)$<br>=0.275     | 0.943<br>(0.690)  | 0                 | 0.004<br>(0.156)  | 0.142<br>(0.097)  | 0.651<br>(0.074) | 0.401<br>(0.071) | -0.330<br>(0.033) | -0.373<br>(0.028) | -0.007<br>(0.099) |
| 4.     | Zellner           | $\delta=0$<br>$\gamma=0$                                  | $F(2,265)$<br>=0.138     | 0.943<br>(0.690)  | 0                 | 0                 | 0.651<br>(0.097)  | 0.402<br>(0.074) | 0.402<br>(0.071) | -0.329<br>(0.032) | -0.372<br>(0.027) | -0.009<br>(0.069) |
| 5.     | Zellner           | $\alpha_1 = \alpha_2$                                     | $F(1,265)$<br>=1.674     | 0.938<br>(0.702)  | -0.016<br>(0.075) | 0.015<br>(0.155)  | 0.103<br>(0.099)  | 0.647<br>(0.077) | 0.396<br>(0.073) | -0.357<br>(0.024) | -0.357<br>(0.024) | 0.004<br>(0.100)  |
| 6.     | Zellner           | $\alpha_1 = \alpha_2$<br>$\alpha_3 = 0$                   | $F(2,265)$<br>=0.838     | 0.939<br>(0.701)  | -0.016<br>(0.075) | 0.010<br>(0.111)  | 0.130<br>(0.099)  | 0.647<br>(0.077) | 0.396<br>(0.073) | -0.357<br>(0.022) | -0.357<br>(0.022) | 0                 |
| 7.     | Zellner           | $\delta=0$<br>$\alpha_1 = \alpha_2$                       | $F(2,265)$<br>=0.859     | 0.952<br>(0.700)  | 0                 | 0.014<br>(0.155)  | 0.129<br>(0.098)  | 0.643<br>(0.075) | 0.394<br>(0.072) | -0.357<br>(0.024) | -0.357<br>(0.024) | 0.004<br>(0.100)  |
| 8.     | Zellner           | $\delta = \gamma = \alpha_3 = 0$<br>$\alpha_1 = \alpha_2$ | $F(4,265)$<br>=0.432     | 0.951<br>(0.699)  | 0                 | 0                 | 0.129<br>(0.098)  | 0.643<br>(0.075) | 0.394<br>(0.072) | -0.357<br>(0.022) | -0.357<br>(0.022) | 0                 |
| 9.     | Zellner           | $\alpha_1 = \alpha_2 = \beta_1$                           | $F(2,265)$<br>=13.534    | -1.534<br>(0.514) | 0.019<br>(0.080)  | -0.032<br>(0.157) | -0.335<br>(0.024) | 0.583<br>(0.081) | 0.452<br>(0.077) | -0.335<br>(0.024) | -0.335<br>(0.024) | -0.035<br>(0.099) |
| 10.    | Zellner           | $\beta_2 + \beta_3 = 1$                                   | $F(1,265)$<br>=1.504     | 1.103<br>(0.677)  | 0.105<br>(0.072)  | -0.001<br>(0.160) | 0.147<br>(0.095)  | 0.614<br>(0.070) | 0.386<br>(0.070) | -0.321<br>(0.037) | -0.374<br>(0.029) | -0.014<br>(0.099) |

Equation 1:  $\text{LREALTP2} = \text{Constant} + \delta \text{ LARGE SIZEDUM} + \gamma \text{ Tenancy Proxy} + \beta_1 \text{ LREAWGE} + \beta_2 \text{ LTOTLAMD} + \beta_3 \text{ LKAPITAL}$ .Equation 2:  $\text{DEPV4} = \alpha_1 \text{ LARGE SIZEDUM} + \alpha_2 \text{ SMALLDUM} + \alpha_3 \text{ Tenancy Proxy}$ .Notes: Parentheses contain asymptotic standard errors.  $n = 137$ .

Table 4.1.4 Mexican wheat profit functions (1969/70)

| Number | Estimation method | Restrictions                                      | F value for restrictions | Constant         | $\delta$          | $\gamma$         | $\beta_1$         | $\beta_2$        | $\beta_3$        | $\alpha_1$        | $\alpha_2$        | $\alpha_3$        |
|--------|-------------------|---------------------------------------------------|--------------------------|------------------|-------------------|------------------|-------------------|------------------|------------------|-------------------|-------------------|-------------------|
| 1.     | OLS               | none                                              | -                        | 1.105<br>(0.788) | -0.069<br>(0.109) | 0.076<br>(0.160) | -0.078<br>(0.141) | 0.855<br>(0.091) | 0.229<br>(0.067) | -0.323<br>(0.037) | -0.391<br>(0.030) | 0.003<br>(0.100)  |
| 2.     | Zellner           | none                                              | -                        | 2.567<br>(0.570) | 0.049<br>(0.092)  | 0.053<br>(0.159) | 0.173<br>(0.102)  | 0.802<br>(0.066) | 0.192<br>(0.048) | -0.321<br>(0.037) | -0.378<br>(0.029) | -0.011<br>(0.099) |
| 3.     | Zellner           | $\delta=0$                                        | F(1,265)<br>=0.295       | 2.588<br>(0.565) | 0                 | 0.058<br>(0.159) | 0.181<br>(0.101)  | 0.809<br>(0.063) | 0.195<br>(0.047) | -0.329<br>(0.034) | -0.372<br>(0.028) | -0.008<br>(0.099) |
| 4.     | Zellner           | $\delta=0$<br>$\gamma=0$                          | F(2,265)<br>=0.220       | 2.597<br>(0.565) | 0                 | 0                | 0.181<br>(0.101)  | 0.810<br>(0.063) | 0.195<br>(0.047) | -0.326<br>(0.033) | -0.369<br>(0.027) | 0.033<br>(0.071)  |
| 5.     | Zellner           | $\alpha_1=\alpha_2$                               | F(1,265)<br>=1.614       | 2.569<br>(0.574) | -0.017<br>(0.079) | 0.068<br>(0.159) | 0.169<br>(0.103)  | 0.803<br>(0.066) | 0.192<br>(0.048) | -0.356<br>(0.024) | -0.356<br>(0.024) | 0.003<br>(0.100)  |
| 6.     | Zellner           | $\alpha_1=\alpha_2$<br>$\alpha_3=0$               | F(2,265)<br>=0.808       | 2.569<br>(0.574) | -0.012<br>(0.079) | 0.065<br>(0.116) | 0.169<br>(0.103)  | 0.803<br>(0.066) | 0.192<br>(0.048) | -0.356<br>(0.022) | -0.356<br>(0.022) | 0                 |
| 7.     | Zellner           | $\delta=0$<br>$\alpha_1=\alpha_2$                 | F(2,578)<br>=0.817       | 2.578<br>(0.573) | 0                 | 0.067<br>(0.159) | 0.168<br>(0.102)  | 0.801<br>(0.064) | 0.190<br>(0.047) | -0.356<br>(0.024) | -0.356<br>(0.024) | 0.003<br>(0.100)  |
| 8.     | Zellner           | $\delta=\gamma=\alpha_3=0$<br>$\alpha_1=\alpha_2$ | F(4,265)<br>=0.490       | 2.590<br>(0.573) | 0                 | 0                | 0.169<br>(0.102)  | 0.803<br>(0.064) | 0.189<br>(0.048) | -0.356<br>(0.022) | -0.356<br>(0.022) | 0                 |
| 9.     | Zellner           | $\alpha_1=\alpha_2=\beta_1$                       | F(2,265)<br>=14.321      | 0.109<br>(0.325) | 0.027<br>(0.085)  | 0.031<br>(0.161) | -0.334<br>(0.024) | 0.758<br>(0.070) | 0.221<br>(0.052) | -0.334<br>(0.024) | -0.334<br>(0.024) | -0.035<br>(0.100) |
| 10.    | Zellner           | $\beta_2+\beta_3=1$                               | F(1,265)<br>=0.029       | 2.653<br>(0.553) | 0.037<br>(0.553)  | 0.048<br>(0.161) | 0.187<br>(0.099)  | 0.812<br>(0.046) | 0.188<br>(0.046) | -0.321<br>(0.037) | -0.375<br>(0.029) | -0.013<br>(0.099) |

Equation 1: LREALTP2=Constant+ $\delta$  LARGE SIZEDUM+ $\gamma$ Tenancy Proxy+ $\beta_1$  LREAWAGE+ $\beta_2$  LTOTLAND+ $\beta_3$  LCAPFER.Equation 2: DEPV3= $\alpha_1$  LARGE SIZEDUM+ $\alpha_2$  SMALLDUM+ $\alpha_3$  Tenancy Proxy.Notes: Parentheses contain asymptotic standard errors.  $n=137$ .

Table 4.1.5 Mexican wheat profit functions (1969/70)

| Number | Estimation method | Restrictions                                      | F value for restrictions | Constant         | $\delta$          | $\gamma$         | $\beta_1$         | $\beta_2$        | $\beta_3$         | $\alpha_1$        | $\alpha_2$        | $\alpha_3$        |
|--------|-------------------|---------------------------------------------------|--------------------------|------------------|-------------------|------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| 1.     | OLS               | none                                              | -                        | 2.595<br>(0.748) | -0.004<br>(0.116) | 0.055<br>(0.167) | -0.019<br>(0.146) | 1.102<br>(0.086) | 0.010<br>(0.060)  | -0.323<br>(0.037) | -0.391<br>(0.030) | 0.003<br>(0.100)  |
| 2.     | Zellner           | none                                              | -                        | 3.960<br>(0.546) | 0.113<br>(0.098)  | 0.028<br>(0.166) | 0.230<br>(0.107)  | 1.029<br>(0.063) | -0.012<br>(0.044) | -0.321<br>(0.037) | -0.374<br>(0.029) | -0.013<br>(0.099) |
| 3.     | Zellner           | $\delta=0$                                        | F(1,265)<br>=1.396       | 3.970<br>(0.546) | 0                 | 0.042<br>(0.166) | 0.243<br>(0.106)  | 1.044<br>(0.061) | -0.001<br>(0.043) | -0.338<br>(0.034) | -0.365<br>(0.028) | -0.006<br>(0.099) |
| 4.     | Zellner           | $\delta=0$<br>$\gamma=0$                          | F(2,265)<br>=0.732       | 3.975<br>(0.546) | 0                 | 0                | 0.243<br>(0.107)  | 1.045<br>(0.061) | -0.001<br>(0.043) | -0.336<br>(0.033) | -0.363<br>(0.027) | -0.023<br>(0.073) |
| 5.     | Zellner           | $\alpha_1=\alpha_2$                               | F(1,265)<br>=1.494       | 3.955<br>(0.550) | 0.053<br>(0.085)  | 0.044<br>(0.166) | 0.226<br>(0.108)  | 1.029<br>(0.063) | -0.010<br>(0.044) | -0.355<br>(0.024) | -0.355<br>(0.024) | 0.000<br>(0.100)  |
| 6.     | Zellner           | $\alpha_1=\alpha_2$<br>$\alpha_3=0$               | F(2,265)<br>=0.747       | 3.955<br>(0.550) | 0.053<br>(0.085)  | 0.043<br>(0.123) | 0.226<br>(0.108)  | 1.029<br>(0.063) | -0.010<br>(0.044) | -0.355<br>(0.022) | -0.355<br>(0.022) | 0                 |
| 7.     | Zellner           | $\delta=0$<br>$\alpha_1=\alpha_2$                 | F(2,265)<br>=0.958       | 3.955<br>(0.550) | 0                 | 0.048<br>(0.166) | 0.234<br>(0.107)  | 1.039<br>(0.061) | -0.004<br>(0.043) | -0.355<br>(0.024) | -0.355<br>(0.024) | 0.001<br>(0.100)  |
| 8.     | Zellner           | $\delta=\gamma=\alpha_3=0$<br>$\alpha_1=\alpha_2$ | F(4,265)<br>=0.518       | 3.964<br>(0.549) | 0                 | 0                | 0.234<br>(0.107)  | 1.041<br>(0.061) | -0.005<br>(0.043) | -0.355<br>(0.022) | -0.355<br>(0.022) | 0                 |
| 9.     | Zellner           | $\alpha_1=\alpha_2=\beta_1$                       | F(2,265)<br>=15.672      | 1.352<br>(0.274) | 0.101<br>(0.091)  | 0.005<br>(0.169) | -0.333<br>(0.024) | 1.005<br>(0.068) | -0.001<br>(0.048) | -0.333<br>(0.024) | -0.333<br>(0.024) | -0.038<br>(0.100) |
| 10.    | Zellner           | $\beta_2=\beta_3=1$                               | F(1,265)<br>=0.198       | 4.028<br>(0.532) | 0.134<br>(0.081)  | 0.015<br>(0.169) | 0.242<br>(0.104)  | 1.011<br>(0.042) | -0.011<br>(0.042) | -0.321<br>(0.037) | 10.372<br>(0.029) | 10.016<br>(0.099) |

Equation 1: IREALTP2= Constant +  $\delta$  LARGE SIZEDUM +  $\gamma$  Tenancy Proxy +  $\beta_1$  IREAWAGE +  $\beta_2$  LTOTLAND +  $\beta_3$  LOGCAP.Equation 2: DEPV4 =  $\alpha_1$  LARGE SIZEDUM +  $\alpha_2$  SMALLDUM +  $\alpha_3$  Tenancy Proxy.Notes: Parentheses contain asymptotic standard errors.  $n=137$ .

definitions of capital. For a narrow definition of capital (excluding manures and fertilisers), LOGCAP, it comes out to be insignificant and sometimes has a wrong sign. For the other two definitions it has the right sign and is significant.<sup>17</sup> In the profit equation the Large Size Dummy and the Tenancy Proxy are always insignificant.

Let us examine the tests of economic, technical and price efficiency. For all definitions of capital the results are the same, and therefore easy to summarise. We cannot reject the hypothesis of equal relative economic, technical and price efficiency of small and large farms. We reject, at the 5 percent significance level, absolute price efficiency of small or large farms, i.e. they do not achieve *perfect* profit-maximisation ( $k^i = k^j \neq 1$ ). Again, we cannot reject the hypothesis of equal relative economic, technical and price efficiency of tenant and owner farms. Finally, we cannot reject the hypothesis of constant returns to scale in *all* inputs.

Having summarised the results, let us take a critical look at them. Since we find a 'key' neoclassical variable, the real wage rate, turning out with the wrong sign (and, to add to the discomfort, it is often significant!) the implication is that the model is misspecified and hence all parameter estimates are biased. Under the circumstances, tests of restrictions on parameters, within and across equations, are not meaningful and hence we should handle these results with caution. At this juncture it is worth discussing some 'alibis'.

#### (a) Wrong Functional Form?

It is possible to argue that the poor results we have obtained are due to choosing the wrong functional form for the production function. However, most previous investigators have found that the Cobb-Douglas production function fits quite well to Indian agricultural data. An obvious alternative functional form is the CES, but with three inputs this would lead to increased complications in the estimation. In any case since a Cobb-Douglas production function allows a great deal of substitutability it gives a fair chance to neoclassical theory.

#### (b) Aggregation over Time: The Importance of Dating Inputs?

The agricultural production process can best be described as a 'flow-input, point-output' process. Specifically, decisions about the flow of inputs are made *sequentially* in the light of the states of nature that prevailed in the previous periods. Even if we assume complete certainty we can ignore the timing of inputs and simply use an aggregate over the year (crop season): (a) if there is strict (perfect) substitutability or complementarity over time; or (b) if all farmers are maximising profits (or minimising costs) subject to the *same* set of prices within the year (crop season). In this latter case Hicks' composite good theorem allows us to aggregate since relative prices at different points in time are constant.

It is clear that there is not strict substitutability over time; labour used in planting cannot be (perfectly) substituted for labour used in harvesting. Similarly, there is no strict complementarity over time; labour used in

planting and harvesting are clearly related, but not in fixed proportions. It is also well known that in less developed countries different farmers do *not* face the same set of prices. Small farms mainly rely on family labour. Large farms hire labour at varying prices over the year (there is a clear seasonal pattern in casual labour wages rates) while small farms do not have to pay high wage rates during peak (e.g. harvesting) seasons.

The importance of the timing of inputs can be seen from the differences in average yield of Mexican wheat per hectare in 1969/70 according to the date of planting: 24.04 quintals in the first fortnight of November, 27.85 quintals in the second fortnight of November, 19.17 quintals in the first fortnight of December, and 16.65 quintals in the second fortnight of December.<sup>18</sup>

Loss of information of this kind *may* explain the results we obtained where the wage variable turned up with an incorrect sign. However, even if the data were available with dated inputs, estimation of a profit function would be difficult because many of the values of variables would be zero, and thus we would be unable to take logarithms. (A Cobb-Douglas production function would not represent such possibilities.)

### (c) Variable Inputs Other than Labour?

In our estimation we have assumed that labour is the only variable input. Except for trial runs we did not distinguish between casual hired labour and permanent hired labour.<sup>19</sup> Clearly, there are other variable inputs but the unavailability of price series for them prevented us from extending the model to take account of them. An important variable input which we had to ignore was fertilisers, due to the lack of a farm-specific price series.

### (d) Fixed Inputs?

In my view, for the agricultural production process it is difficult to conceive of a *fixed input* although it is easy to have *fixed costs*. Land is often treated as a fixed input, but this is far from the truth. Farmers have a choice of leasing out land (and sometimes leasing in) to alter the size of the farm. There is a choice of crop composition: how much land is allocated to different crops in the same season. There is choice of how many crops to grow in a year. Within each season there is a decision about how much land to leave fallow. For our study we have only looked at one crop in one season, but even in the short run (before the planting) the farmer can increase/decrease his cultivated land by leasing in/out land or by varying the amount of fallow.

Similarly, capital has been treated as a 'fixed input'. In addition to any problems involved in using a value measure of capital, it is clear that a farmer has a choice about the services of capital he employs. The farmer decides how long he uses a tractor to plough the land, how long he uses a pump to draw water from a tube well, etc. These decisions arise because of the additional costs involved in utilisation of the capital goods (electricity charges, diesel costs, costs of depreciation with use, etc.). It is clear that the



capital variable performs very poorly in the model until we include the value of fertilisers and manures, which are really variable costs.<sup>20</sup> Thus, to use land and capital as fixed inputs in a restricted profit function approach is a misspecification and would lead to biased parameter estimates. In other words, this approach faces the same problems as in estimating production functions with ordinary least squares.

#### (e) Heteroscedasticity?

It is possible that our estimation of the restricted profit function has been subject to heteroscedastic errors, thus vitiating some of our conclusions. To check for heteroscedasticity I plotted the residuals against farm size and there was no apparent relationship. However, no formal tests of heteroscedasticity were carried out.

#### (f) Utility Maximisation, not Profit Maximisation?<sup>21</sup>

It is possible that our estimation of the restricted profit function has been and not profits such that there are substitution effects and *income effects*. If each farmer has a monopoly of an input (entrepreneurial talent) which he supplies to himself this would generate income effects and hence give an ambiguous sign to the wage rate. However, in our analysis we are assuming that the labour market is competitive and the farmer imputes a market wage to his family labour.<sup>22</sup> Similarly, we are defining profit to be the value of *total production* (not marketed sales) less labour costs (including imputed family labour costs in our dependent variables LREALMP2 and LREALTP2) and hence the farmer can first maximise profits and then maximise utility. Note that we are not concerned with the effect of a change in the wage rate on the farmer's leisure but only on the *total* labour input. We are also not concerned with the farmer's decision on marketed output. In these latter two cases maximising utility would give ambiguous results. Hence, in the case of competitive labour markets maximising utility does not give us different *a priori* restrictions on parameter signs.

#### (g) Wages as a Share of Output: Simultaneity?<sup>23</sup>

If *all* wages were paid on the basis of a share of the farm output (casual labour at harvest time is sometimes paid on this basis) it may be argued that one is regressing a whole on its part. To explain this argument, assume  $r$  to be the proportionate share ( $r < 1$ ) paid to workers,  $Y$  the value of output deflated by the output price, and other symbols as previously defined. We have:

$$Y - wL = f(w; Z)$$

where:

$$wL = rY$$

and hence:

$$w = \frac{rY}{L}$$

By substitution:

$$Y - rY = (1 - r)Y = f\left(\frac{rY}{L}; Z\right).$$

Now if  $L$  were a constant we would be regressing  $(1 - r)Y$  on  $rY$  and hence get a positive coefficient. However,  $L$  is not a constant and its variance is non-eligible relative to  $Y$ . Since  $Y$  and  $1/L$  are negatively correlated, the two work in opposite directions and the net effect is ambiguous. Thus, we reject this alibi even allowing for the extreme (and false) assumption of *all* labour being paid on a share of output basis.<sup>24</sup> Since we are assuming the labour market is competitive, the supply of labour is infinitely elastic to farms; we are thus estimating only labour demand.

#### (h) Comparisons

Using Farm Management Studies (grouped) data from the mid 1950s, Lau-Yotopoulos [1971, 1973] test the restricted profit function model. They find a negative and significant coefficient for the wage variable, and a negative(!) and significant coefficient for capital.<sup>25</sup> This clearly suggests a misspecification and hence *all* their parameter estimates are biased. As such their tests of restrictions on parameter estimates are not meaningful. Since Lau-Yotopoulos use data consisting of groups of unequal sizes, it is likely that they have heteroscedastic disturbances, which would throw further doubt on their results.

In a paper in the *American Economic Review*, Sidhu [1974] presents results based on his unpublished Ph.D. dissertation [1972]. He uses data from the FMS for 1967/68, 1968/69 and another from a sample collected by him for 1969/70 and 1970/71. His definition of capital is similar to our broad definition of capital, i.e. LKAPITAL, and his definition of the wage rate is similar to the one used here (LREAWAGE). However, he assumes that output price is a constant – which it is not – for all farms, and hence uses a *nominal* wage. It is interesting to note that for 1967/68 and 1968/69 he obtains a positive coefficient for the wage term, *except when he imposes restrictions which an F-test rejects!* For 1969/70 (the same year as I am using but with a different sample) he obtains a negative and significant coefficient with OLS estimation, and when he imposes restrictions which he rejects at the 5 percent level.<sup>26</sup> In 1970/71, the wage coefficient is negative but significant only when he imposes the restriction of absolute price efficiency. For a pooled sample (1967/68–1970/71) the wage coefficient is negative but significant only when he imposes restrictions that an F-test rejects. Thus, overall, his results

do not conflict with our findings. Ignoring the 'maverick' wage variable, he finds no difference between small and large farms but, disturbingly (not that he is worried), finds increasing returns to scale for 1967/68, 1970/71 and for the pooled sample. Since the pooled sample is a fairly long-run period, it is worrying to find increasing returns to scale (i.e. no maximum exists!). In any case, as it is a short-run model it should not be estimated for a longer-run period.

From a critical review of these papers it should be clear that the profit function model does not perform very well. As such, we cannot derive any valid policy conclusions from the results.

## V Conclusions

Our results suggest that the restricted profit function approach based on a simple Cobb-Douglas production function does not perform very well. Since we find that the key neoclassical variable (the wage rate) has the wrong sign (and is sometimes not significantly different from zero), we reject the hypothesis of profit maximisation. This conclusion is reached even allowing for systematic under- or over-valuation of the wage rate ( $k \neq 1$ ). Since this implies a mis-specified model, it is difficult to put much stress on the other features, such as the lack of difference between small and large farms, and between owners and tenants. As mentioned above, these results *may* be explained due to a mis-specified production function and poorly measured variables (e.g. capital).

It may be argued that a more general neoclassical model allowing for the production of multiple outputs under uncertainty could be formulated which would perform better. However, in my opinion, the neoclassical profit-maximising model is particularly bad at explaining the behaviour of farmers in less developed countries as it ignores the sociopolitical matrix within which they act and react. Farmers in less developed countries do not act as price takers (and quantity adjusters) in competitive markets. The large (and rich) farmers have a fair amount of economic and political power in village communities and over the credit agencies. Some farmers have almost feudal powers over their workers, and wages paid are not 'market-determined'. All this is *not* to imply that farmers are stupid and irrational, but that the individualistic nature of the neoclassical model is inappropriate as it ignores the historical context within which the farmers are operating.

To conclude, my results cast sufficient doubt on a simple neoclassical model to call for exploration of other avenues of research.<sup>27</sup>

## Notes

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1. For recent discussions of this debate, see Chattopadhyay and Rudra [1976].
2. See Sen [1975].
3. See Junankar [1976a] and references cited therein. For some tests of Marshallian versus Cheung hypotheses on share tenancy, see Bell [1977].
4. Earlier work includes an important paper by Hopper [1965]. However, he does not distinguish between technical and price efficiency (see the next section). His results are subject to simultaneous equation bias which make them suspect.
5. Details are available from the author; they follow the derivation given in Yotopoulos and Lau [1973].
6. See FMS Combined Report [Kahlon and Miglani, 1974].
7. See FMS Combined Report [Kahlon and Miglani, 1974: 27–8].
8. For further details see Junankar (1976b), We later refer to farms of less than five hectares as ‘small’.
9. The main product is valued at harvest prices, while the byproduct is valued at harvest time according to its quality. See FMS Combined Report. [Kahlon and Miglan; 1974].
10. Note that this would involve an element of double counting as it is included under the interest on working capital.
11. For full details of how these variables were measured or estimated see FMS Combined Report [Kahlon and Miglan; 1974].
12. A casual look suggests that the results for LREALMP1 and LREALTP2 are similar, as are LREALMP2 and LREALTP2. This suggests our assumption of fixed proportions between byproduct and main product is reasonable.
13. These regressions were re-run using the wage rate of hired labour only with substantially the same results. I also tried using a casual hired labour wage rate and an annual farm servants wage rate in a profit function (i.e. assuming two variable inputs, casual labour and permanent labour) but they both came out with a wrong sign and were not significant.
14. For details see Yotopoulos and Lau [1973].
15. Similar results were obtained using other dependent variables. We are, due to data limitations, ignoring other variable inputs.
16. When the equations are estimated by OLS, the wage coefficient turns out to be negative but very poorly defined. In any case the model as set out should be estimated by Zellner’s method, which increases the efficiency of our estimates.
17. See IV(d) *Fixed Inputs*?
18. FMS Combined Report [Kahlon and Miglan: 1974: 231]. For the importance of timing fertilisers, see Minhas *et al* [1974].
19. Perhaps it is worth noting that casual hired labour is sometimes paid on a piece-work basis, or a share-cropping basis. The wage rate on a per unit of time basis is therefore a derived variable, and not like a normal ‘price’ variable. In some recent work, for another state, I distinguished three variable inputs: family and annual servant labour, casual hired labour, and bullock labour. The results, however, still reject the model.
20. Compare Tables 4.1.3, 4.1.4 and 4.1.5.

21. This argument was suggested to me by Professor A. R. Bergstrom, who also brought to my attention a paper by Graaff [1950–51], Roy Bailey and Mike Martin helped me clarify the arguments. See also Lipton [1968].
22. Some farmers hire out their labour, and some 'exchange' labour with other farmers.
23. This argument was suggested to me in the Tuesday seminar at Essex, by Professor C.J. Bliss and D. Sathaye.
24. A large majority of the farmers used annual servants. Only a fraction of their wage would be directly related to the output.
25. Their definition of capital is similar to our definition LOGCAP. We also find that this variable sometimes turns up with a negative sign, although it is usually insignificant. See Table 4.1.5.
26. There is a typographical error in the AER [Sidhu, 1974] paper, assuming the thesis [Sidhu, 1972] to be correct. The standard error for  $\beta_1$  with one restriction is 0.106 not 0.016.
27. See Bhaduri [1973] for an interesting analysis of inter-related credit and factor markets.

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# 4.2

## Do Indian Farmers Maximise Profits?

P. N. Junankar

*The aim of this paper is to test the hypothesis that Indian farmers maximise profits under neo-classical competitive conditions. We use a restricted profit function model (using duality theory) which gives us a set of equations that can be estimated subject to the restrictions imposed by neo-classical economic theory. Using Farm Management Studies data from the Thanjavur district of Tamil Nadu (India) for 1969/70 we test the model. Our results reject the model conclusively. We conclude the paper with a discussion of the possible reasons for the rejection of the model.*

### 1 Introduction

The aim of this paper is to test the hypothesis that Indian farmers are neo-classical profit maximising agents. The approach followed is to use econometric methods to test the restricted profit function model using cross-section data from the Thanjavur district of Tamil Nadu (India) for 1969/70. The plan of this paper is as follows: in the remaining part of this Section I shall outline the model and compare the approach with earlier work in this field. In Section 2 I shall discuss the main characteristics of the sample district, some of the problems of the data used and a list of variables used in the econometric work. In Section 3 the model is estimated by Zellner's Seemingly Unrelated Regressions method and the restrictions implied by the theory are tested. An alternative formulation of the model is also estimated and the restrictions tested. Finally, Section 4 concludes with a summary of the results and a few general comments. To anticipate the conclusions, our results do not support the Restricted Profit Function Model.

The aim of this paper is to see whether a static neo-classical model for competitive farms operating under certainty is appropriate for the agricultural

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sector of a less developed country. The assumptions of competitive profit maximising behaviour underlie various studies of supply responses of farmers in less developed economies. [Askari and Cummings, 1977] However, there are very few direct tests of profit maximising behaviour of farmers which use microeconomic data.<sup>1</sup> To be precise, we are testing the joint hypothesis of profit maximising behaviour *and* competitive behaviour. A rejection of the model implies a rejection of this joint hypothesis: the farmers *may* be profit maximisers under alternative market conditions.

In a paper, Yotopoulos and Lau [1973] argue that the profit function model is consistent with the data although Junankar [1980] finds results that contradict the model. As much advice to Governments is based on neoclassical models, it seems obvious that we should try to see whether the theory is supported by the evidence.

I now turn to outline the restricted profit function model. This approach uses duality theory to obtain a profit function and input demand functions given a production technology and given input and output prices.<sup>2</sup> To simplify the estimation of the model we assume a Cobb-Douglas production function:

$$\ln Y = \ln A + \sum \alpha_i \ln X_i + \sum \delta_i \ell n Z_i \quad (1)$$

where  $0 < \alpha_i, \delta_i < 1$  and  $\sum \alpha_i < 1$

where  $Y$  is output,  $A$  is a constant,  $X_i$  are the variable inputs,  $Z_i$  are the fixed inputs and  $\alpha_i, \delta_i$  are parameters.

If the farm maximises profits in the *short run* it takes  $Z_i$  as given:

$$\text{Max } \Pi' = PY - \sum c'_i X_i \quad (2)$$

( $\Pi'$  is nominal profits and  $c'_i$  are the nominal input prices) which gives us the restricted profit function (where the  $X_i$  have been maximised out) as

$$\begin{aligned} \Pi &= B \prod_{i=1}^n c_i^{\beta_i} \prod_{j=1}^m Z_j^{\gamma_j} \\ \ln \Pi &= \beta_0 + \sum_{i=1}^n \beta_i \ln c_i + \sum_{j=1}^m \gamma_j \ln Z_j \\ \beta_i &= -\alpha_i(1 - \sum \alpha_j)^{-1} < 0; \gamma_j = \delta_j(1 - \sum \alpha_j)^{-1} > 0 \end{aligned} \quad (3)$$

(where  $\Pi$  and  $c_i$  have been normalised by output price). By Hotelling's lemma the input demand functions are derived simply by differentiating the profit function<sup>3</sup> with respect to the input price. Thus

$$X_i = -\beta_i c_i^{-1} (B c_1^{\beta_1} c_2^{\beta_2} \dots Z_1^{\gamma_1} Z_2^{\gamma_2} \dots) \quad (4)$$



or

$$\frac{-c_i X_i}{\Pi} = \beta_i \quad (5)$$

An alternative form of (4) is

$$c_i X_i = (-\beta_i) \cdot B c_1^{\beta_1} \dots Z_1^{\gamma_1} \dots \quad (6)$$

or, in log-linear form

$$\ln(c_i X_i) = \Theta_i + \sum \beta_j \ln c_j + \sum \gamma_j \ln Z_j \quad i=1, \dots, n \quad (7)$$

where  $B$  and  $\Theta_i$  are constants. It should be noted that equations (3) and (5) are a set of simultaneous equations, where equations (5) are derived from (3). Similarly, equations (7) are derived from (4) and the parameters  $\beta_i, \gamma_j$  in equations (7) are precisely the same as those in equation (3). We now assume (in an *ad hoc* fashion) that equations (3), (5) and (7) are stochastic equations with error terms with the normal properties except that we allow for the errors *across* equations to have a variance-covariance matrix  $\Omega$ . By assumption  $c_j$  and  $Z_j$  are pre-determined variables so we avoid any simultaneous equation bias. Using Zellner's Seemingly Unrelated Regressions method we get asymptotically efficient estimates of the parameters.

For purposes of estimation and hypothesis testing let us rewrite the equations as follows:

$$\ln \Pi = \beta_o + \sum_{i=1}^n \beta_i \ln c_i + \sum_{i=1}^m \gamma_i \ln Z_i + u \quad (3a)$$

$$-\frac{c_i X_i}{\Pi} = b_i + u_i \quad i = 1, \dots, n \quad (5a)$$

$$\ln(c_j X_j) = \Theta_j + \sum_{i=1}^n b_i \ln c_i + \sum_{i=1}^m g_i \ln Z_i + u_j \quad j = 1, \dots, n \quad (7a)$$

The theory can now be tested by *either* estimating equations (3a) and (5a) (call it 'Alternative A') *or* estimating equations (3a) and (7a), (call it 'Alternative B').

The tests for Alternative A are:

- (i)  $H_o: \beta_i = 0; H_1: \beta_i < 0 \quad i=1, \dots, n$
- (ii)  $H_o: \gamma_i = 0; H_1: \gamma_i > 0 \quad i=1, \dots, m$
- (iii)  $H_o: \beta_i = b_i; H_1: \beta_i \neq b_i \quad i=1, \dots, n$

The tests for Alternative B are the same as above plus

- (iv)  $H_o: \gamma_i = g_i; H_1: \gamma_i \neq g_i \quad i=1, \dots, m.$

Although these two alternatives are mathematically identical, when treated in a stochastic framework they are estimated by different methods. Alternative A is estimated by Zellner's seemingly unrelated regressions method using the correlation of errors across equation to increase efficiency. Alternative B is estimated by Ordinary Least Squares as there is no gain in efficiency if the set of regressors in all the equations are identical. From an economic point of view, Alternative B allows us to see *which* variable(s) satisfies our *a priori* sign restrictions.

In an earlier paper, [Junankar, 1980] I presented tests of the profit function model ('Alternative A' version) using data from the Ferozepur district of Punjab. It was found that the data did not support the theory. I noted that a possible reason for the negative results was that not enough variable inputs had been specified. In this paper I allow for three variable inputs *viz.* bullock labour and two types of human labour. Another possible reason for the negative results was that the agricultural production process is a sequential process and we need to specify the *timing* of inputs. A small move in this direction (subject to data limitations) has been made in this paper by distinguishing between casual hired labour on the one hand, and family and annual servant labour on the other. We assume that all farms use casual labour *only* in the 'peak' season and family and annual servant labour is used in the 'peak' and 'slack' seasons *in fixed* proportions.<sup>4</sup> As we do not have data on the use of labour on a month-to-month basis, we are only able to proxy the time profile by the crude assumption made above. An alternative interpretation of defining two types of labour is that there is a *qualitative* difference in the two kinds of labour. Family and annual servant labour would provide more 'loving care' to the land, while casual labour would not be interested in the output of the farm. (Some farmers provide a wage at harvest time on a share-crop basis. This saves the farmer supervision costs and is meant to give labour an incentive to be efficient.)

To summarise, this paper extends the model of my previous paper to include three variable inputs and two fixed inputs. It also provides a more direct test of the profit function model by testing 'Alternative B'. In the next section I turn to discuss the data.

## 2 The data

The data for this paper comes from the Farm Management Studies for the Thanjavur district of Tamil Nadu for the year 1969/70. This district is relatively prosperous (popularly known as the 'granary of Tamil Nadu') where a large proportion of the land is under high yielding varieties of paddy. The main crop of this region is paddy, and as this is a well irrigated area, three crops are cultivated in a year. The three crop seasons are: Kuruva (June to September), Samba (August to January), and Thaladi (September/October to February/March). The ownership of land is pretty unequal (e.g. only 18 per cent of the total area is cultivated by 47 per cent of the farmers who

own 2.02 hectares or less). The average farm size is 3.09 hectares. Leasing-in of lands is common among small farmers: the average size of holding of an owner-cum-tenant is 2.71 hectares. Of the land devoted to paddy cultivation in the Kuruvai season, most of it is under the HYV called ADT-27 (92.6 per cent) and the remaining is under the local or *desi* variety. Similarly, for the Samba season, 81.7 per cent of the land devoted to paddy is under a HYV called CO 25, and the remainder to the *desi* variety. In the Thaladi season only 55.7 per cent of the land devoted to paddy is under the HYV called CO 25, while the rest is under the *desi* variety.<sup>5</sup> The Samba crop is primarily for self-consumption, unlike the Kuruvai and Thaladi crop which are primarily for sale. [Ministry of Agriculture, undated, p. 29].

The data are for a stratified random sample of 150 farms collected for the Indian Ministry of Agriculture (Directorate of Economics and Statistics) by the Farm Management Unit at the University of Madras.<sup>6</sup> As all farms did not cultivate three crops, nor did they all cultivate both varieties of paddy (HYV and *desi*) the sample size varies from crop to crop. In this paper I shall use data from the Kuruvai season for ADT 27 and the Samba season for CO 25 (both high yielding varieties of crops). No attempt is made in this paper to explain the crop composition or the sequence of crops cultivated.

### List of Variables

1. L LAND = LOG (Area under crop, hectares)
2. CAP 1 = Depreciation on Implements and Interest on Fixed Capital+Interest on Working Capital (inputs)
3. L CAP 1 = LOG (CAP 1)
4. L CAP 2 = LOG (CAP 1 + Value of Seeds + Value of Manures, Fertilisers, and Pesticides)
5. LRFS WAGE = LOG [(Value of Family Labour + Annual Servants wages/ Days worked by Family Labour and Annual Servants)/ (Output Price)]
6. LRH WAGE = LOG [(Casual Hired Labour Wages/Casual Hired Labour Days)/(Output Price)]
7. LR BUL PRICE = LOG [(Value of Bullock Labour Services/Bullock Labour Days)/(Output Price)]
8. PROF 1 = Value of Main Product – Value of Labour (hired and family)
9. LR PROF 2 = LOG (PROF 1/Output Price)
10. PROF 2 = PROF 1 – Value of Bullock Labour Services
11. LR PROF 2 = LOG [(PROF 2)/Output Price]
12. FS LAB 1 = –(Value of Family Labour + Annual Servant Wages)/ PROF 1
13. FS LAB 2 = – [(Value of Family Labour + Annual Servant Wages)/ (PROF 2)]
14. H LAB 1 = – (Casual Hired Labour Wages/PROF 1)
15. H LAB 2 = [(Casual Hired Labour Wages)/(PROF 2)]

16. BUL = - (Value of Bullock Labour Services/PROF 2)  
 17. LVFS LAB = LOG (Value of Family Labour + Annual Servant Wages)  
 18. LV HIR LAB = LOG (Casual Hired Labour Wages)  
 19. LV BUL = LOG (Value of Bullock Labour Services)

#### Notes

1. Note that all Logs are to the base e.
2. A variable name beginning with an L means it is a natural log and an R signifies a 'real' value.
3. Bullock labour includes owned and hired services. Value of owned bullock labour is based on an imputed cost which includes maintenance costs and depreciation of draught cattle.
4. The value of family labour is based on an imputed wage based on an annual servant's wages.
5. The Casual labour wages and Annual servant wages are based on actual payments made *plus* imputed values for various payments in kind, e.g. food, clothing, etc.

### 3 The tests

In this section I propose to test the Restricted Profit function model as set out in Section 1. Using data for two crop seasons (Kuruwai and Samba) in 1969/70 for the high yielding varieties of paddy I shall first present the results of the estimation of the model as specified in the set of equations (3a) and (5a), and then in the alternative form of equations (3a) and (7a). Although the two versions of the model are mathematically identical, the econometric versions are similar but not identical (see below).

For the tests I have assumed a Cobb-Douglas production function with three variable inputs (i) family and annual servant labour, (ii) casual hired labour and (iii) bullock labour, and two fixed inputs<sup>7</sup> (Land and capital). It is assumed that the production function is concave in the variable inputs and the farms operate under certain, competitive conditions as price takers in input and output markets. Hence the right hand side variables in equation 1 are pre-determined variables. It is assumed that the error terms have the usual properties although the errors across equations are allowed a non-zero covariance. Under these assumptions Zellner's Seemingly Unrelated Regressions method provides asymptotically efficient results. Table 4.2.1 gives the results using a broad definition of capital (LCAP2) which includes the value of seeds, manures, fertilisers and pesticides). Appendix Table 4.2.A.1 gives the corresponding results for the narrow definition of capital (LCAP1). Regression equation 1 gives the results using Ordinary Least Squares (with no restrictions). Equation 2 gives the unrestricted estimates using Zellner's method and equation 3 gives the restricted estimates using Zellner's method. The restrictions (imposed by the theory) are that  $\beta_i = b_i$  for  $i = 1, 2, 3$ .

The first requirement of the theory is that real profits are a decreasing function of the real input prices ( $\beta_i < 0$ ) and an increasing function of the fixed inputs ( $\gamma_i > 0$ ). Looking first at the unrestricted equation for the Kuruwai season  $\beta_1$  and  $\beta_2$  (the coefficients on the wage rates) have the *wrong* sign and are

Table 4.2.1 Profit functions for Thanjavur District (Tamil Nadu) 1969/70

| Regression Eq. No.    | Estimation Method                                                                                                                | F Value for Restrictions | $\beta_0$         | $\beta_1$         | $\beta_2$         | $\beta_3$         | $\gamma_1$       | $\gamma_2$        | $b_1$             | $b_2$             | $b_3$             |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| <i>Kuruvai ADT 27</i> |                                                                                                                                  |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |
| 1.                    | OLS<br>(Unrestricted)                                                                                                            | —                        | 5.866<br>(0.665)  | 0.216<br>(0.240)  | 0.768<br>(0.206)  | -0.234<br>(0.102) | 1.119<br>(0.118) | 0.019<br>(0.104)  | -0.229<br>(0.048) | -0.464<br>(0.073) | -0.198<br>(0.063) |
| 2.                    | Zellner<br>(Unrestricted)                                                                                                        | —                        | 5.789<br>(0.413)  | 0.461<br>(0.148)  | 0.499<br>(0.127)  | -0.148<br>(0.063) | 0.982<br>(0.073) | 0.042<br>(0.065)  | -0.229<br>(0.048) | -0.464<br>(0.073) | -0.198<br>(0.063) |
| 3.                    | Zellner<br>(Restricted)                                                                                                          | F(3,483)<br>=41.227      | 7.713<br>(0.628)  | -0.039<br>(0.035) | -0.166<br>(0.052) | 0.054<br>(0.045)  | 0.903<br>(0.119) | 0.060<br>(0.106)  | -0.039<br>(0.035) | -0.166<br>(0.052) | 0.054<br>(0.045)  |
| <i>Samba CO 25</i>    |                                                                                                                                  |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |
| 1.                    | OLS<br>(Unrestricted)                                                                                                            | —                        | 9.986<br>(2.076)  | -1.886<br>(0.974) | 0.504<br>(0.402)  | -0.319<br>(0.190) | 1.144<br>(0.198) | -0.163<br>(0.197) | -0.318<br>(0.057) | -0.603<br>(0.099) | -0.227<br>(0.048) |
| 2.                    | Zellner<br>(Unrestricted)                                                                                                        | —                        | 9.359<br>(1.933)  | -1.057<br>(0.907) | 0.499<br>(0.374)  | -0.581<br>(0.177) | 1.179<br>(0.184) | -0.237<br>(0.183) | -0.318<br>(0.057) | -0.603<br>(0.099) | -0.227<br>(0.048) |
| 3.                    | Zellner<br>(Restricted)                                                                                                          | F(3,423)<br>=4.53        | 10.172<br>(1.098) | -0.316<br>(0.054) | -0.580<br>(0.094) | -0.226<br>(0.046) | 1.222<br>(0.189) | -0.271<br>(0.189) | -0.316<br>(0.054) | -0.580<br>(0.094) | -0.226<br>(0.046) |
| <i>Equations</i>      |                                                                                                                                  |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |
| 1.                    | LR PROF 2 = $\beta_0 + \beta_1$ LRFS WAGE + $\beta_2$ LRH WAGE + $\beta_3$ LR BUL PRICE + $\gamma_1$ L LAND + $\gamma_2$ L CAP 2 |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |
| 2.                    | FS LAB 2 = $b_1$                                                                                                                 |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |
| 3.                    | H LAB 2 = $b_2$                                                                                                                  |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |
| 4.                    | BUL = $b_3$                                                                                                                      |                          |                   |                   |                   |                   |                  |                   |                   |                   |                   |

Notes: 1. Parentheses contain asymptotic standard errors.

2. Critical values of F distribution: 5% F(3,400) = 2.62, F(3,1000) = 2.61.  
1% F(3,400) = 3.83, F(3,1000) = 3.80.

statistically significant for the Zellner estimation and  $\beta_3$  has the 'correct' sign and is significant.  $\gamma_1$  and  $\gamma_2$  have the correct signs but only  $\gamma_1$  (the coefficient on land) is significant. In the unrestricted estimation for the Samba crop we find  $\beta_1$  (coefficient on family and annual servant labour) has the correct sign but is not significant for the Zellner estimation;  $\beta_2$  (casual hired labour coefficient) has the wrong sign and is not significant<sup>8</sup>;  $\beta_3$  has a correct sign and is significant for the Zellner estimation.  $\gamma_1$  has a correct sign and is significant whilst  $\gamma_2$  has a negative sign and is insignificant. Thus for the unrestricted estimation the theory gets very little support. For the Zellner unrestricted estimates for the Kuruvai and Samba season only land and LR BUL PRICE have a correct sign and are statistically significant. Of the key neo-classical variables (real input prices) there is only *one* variable (bullock labour) for which it is significant and supports the theory. In all other cases the real input prices either have the wrong sign or are not significant. A stronger test of the model is to impose the restrictions that  $\beta_i = b_i$  and to test the restrictions. These results are presented in equation 3. It is clear that the F-test strongly rejects the restrictions for the Kuruvai crop and also rejects it for the Samba crop (both at the 1 per cent level). Similar results are obtained with the narrower definition of capital (see Appendix Table 4.2.A.1). To repeat, these results do not support the neo-classical restricted profit function model.<sup>9</sup>

The next stage in testing the model was to estimate the alternative version of the model (equations 3a and 7a of Section 1). We think that this is a more direct test of the hypothesis since (real) input prices appear in all the equations and we can see which of the input prices are significant. As the right hand side variables are identical in each equation, the Zellner method does not lead to increased efficiency. As such these equations were estimated by Ordinary Least Squares, first without restrictions and then subject to the restrictions specified earlier. These results are presented in Tables 4.2.2 and 4.2.3. The theory requires that the profit function and the variable input demand functions are decreasing functions of the real input prices ( $\beta_i < 0$ ) and increasing functions of the fixed inputs ( $\gamma_i > 0$ ). Looking at the unrestricted estimates first, we find that for the Kuruvai crop for variable input prices, four coefficients have both a correct sign and statistical significance. In all other cases, the coefficients have a wrong sign, or are not significant. (In only six cases out of twelve do the coefficients have a correct sign). In the profit equation *only* land and bullock labour have a correct sign and are significant. For the Samba crop, in seven out of twelve cases the variable input prices come up with a correct sign, and six of these are significant at the 5 per cent level. Surprisingly, the variable which works best is the family and annual servant wage.<sup>10</sup> In the case of fixed inputs, except for the profit equation, land and capital have a correct sign and are significant. The variable input prices do not do very well, although they have a correct sign in just over half the number of cases and significance in exactly half the cases.

Now turning to the restricted estimation ( $b_i = \beta_i$ ) we see that an F test *rejects* the restrictions of equality of coefficients for each variable across equations.

Table 4.2.2 Profit and variable input functions for Kuruvai ADT-27, Thanjavur District (Tamil Nadu) 1969/70

| Eq. No. | Dependent Variable | Estimation Method | Constant          | LRFS WAGE          | LRH WAGE           | LR BUL PRICE       | L LAND            | I CAP 2          |
|---------|--------------------|-------------------|-------------------|--------------------|--------------------|--------------------|-------------------|------------------|
| 1.      | LR PROF 2          | OLS               | 5.866<br>(8.817)  | 0.216<br>(0.899)   | 0.768<br>(3.379)   | -0.234<br>(-2.301) | 1.119<br>(9.477)  | 0.019<br>(0.184) |
| 2.      | LVFS LAB           | "                 | 1.825<br>(1.831)  | 1.164<br>(3.237)   | -0.759<br>(-2.463) | -0.065<br>(-0.425) | 0.206<br>(1.164)  | 0.466<br>(2.977) |
| 3.      | IV HIR LAB         | "                 | 5.428<br>(10.237) | -0.528<br>(-2.763) | 0.237<br>(1.448)   | 0.077<br>(0.949)   | 0.872<br>(9.268)  | 0.116<br>(1.388) |
| 4.      | IV BUL             | "                 | 3.104<br>(5.287)  | -0.936<br>(-4.423) | -0.052<br>(-0.288) | 0.878<br>(9.795)   | 0.295<br>(2.831)  | 0.369<br>(4.005) |
| 5.      | LR PROF 2          | OLS               | 5.955<br>(14.646) | -0.021<br>(-0.146) | 0.049<br>(0.390)   | 0.164<br>(2.661)   | 0.623<br>(8.689)  | 0.242<br>(3.823) |
| 6.      | LVFS LAB           | "                 | 3.185<br>(5.812)  | -0.021<br>(-0.108) | 0.049<br>(0.290)   | 0.164<br>(1.974)   | 0.623<br>(6.446)  | 0.242<br>(2.836) |
| 7.      | IV HIR LAB         | "                 | 4.176<br>(14.417) | -0.021<br>(-0.205) | 0.049<br>(0.548)   | 0.164<br>(3.735)   | 0.623<br>(12.197) | 0.242<br>(5.367) |
| 8.      | IV BUL             | "                 | 2.909<br>(7.460)  | -0.021<br>(-0.152) | 0.049<br>(0.407)   | 0.164<br>(2.775)   | 0.623<br>(9.060)  | 0.242<br>(3.987) |

Notes: 1. A test of the Restrictions for equations 5 - 8 gave  $F(15, 468) = 11.48$ .

The critical values at 5% are  $F(14, 400) = 1.72$  and at 1%  $F(14, 400) = 2.12$ .

2. Parentheses contain t-values.

Table 4.2.3 Profit and variable input functions for Samba CO 25, Thanjavur District (Tamil Nadu) 1969/70

| Eq. No. | Dependent Variable | Estimation Method | Constant         | LRFS WAGE          | LRH WAGE           | LR BUL PRICE       | L LAND            | L CAP 2            |
|---------|--------------------|-------------------|------------------|--------------------|--------------------|--------------------|-------------------|--------------------|
| 1.      | LR PROF 2          | OLS               | 9.986<br>(4.811) | -1.886<br>(-1.936) | 0.504<br>(1.255)   | -0.319<br>(-1.684) | 1.144<br>(5.781)  | -0.163<br>(-0.830) |
| 2.      | LVFS LAB           | "                 | 2.016<br>(1.517) | 1.414<br>(2.266)   | -0.440<br>(-1.709) | -0.233<br>(-1.920) | 0.349<br>(2.753)  | 0.287<br>(2.275)   |
| 3.      | LVHIR LAB          | "                 | 2.430<br>(2.290) | -1.136<br>(-2.280) | 1.389<br>(6.769)   | 0.344<br>(3.546)   | 0.721<br>(7.129)  | 0.350<br>(3.483)   |
| 4.      | LV BUL             | "                 | 3.217<br>(3.833) | -1.334<br>(-3.386) | -0.040<br>(-0.244) | 0.821<br>(10.706)  | 0.367<br>(4.583)  | 0.488<br>(6.135)   |
| 5.      | LR PROF 2          | OLS               | 5.822<br>(5.306) | -0.735<br>(-1.416) | 0.354<br>(1.652)   | 0.153<br>(1.514)   | 0.645<br>(6.118)  | 0.240<br>(2.293)   |
| 6.      | LVFS LAB           | "                 | 3.701<br>(4.557) | -0.735<br>(-1.936) | 0.354<br>(2.259)   | 0.153<br>(2.070)   | 0.645<br>(8.364)  | 0.240<br>(3.135)   |
| 7.      | LV HIR LAB         | "                 | 4.572<br>(7.159) | -0.735<br>(-2.463) | 0.354<br>(2.872)   | 0.153<br>(2.632)   | 0.645<br>(10.637) | 0.240<br>(3.987)   |
| 8.      | LV BUL             | "                 | 3.482<br>(5.891) | -0.735<br>(-2.661) | 0.354<br>(3.103)   | 0.153<br>(2.844)   | 0.645<br>(11.491) | 0.240<br>(4.307)   |

Notes: 1. A test of the restrictions for equations 5 – 8 gave  $F(15, 408) = 12.79$ .

The critical values at 5% are  $F(14, 400) = 1.72$  and at 1%  $F(14, 400) = 2.12$ .

2. Parentheses contain t-values.



Appendix Table 4.2.A.1 Profit functions for Thanjavur district (Tamil Nadu) 1969/70

| Regression            | Estimation                | F value for         | $\beta_0$        | $\beta_1$         | $\beta_2$         | $\beta_3$         | $\gamma_1$       | $\gamma_2$        | $b_1$             | $b_2$             | $b_3$             |
|-----------------------|---------------------------|---------------------|------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| <i>Kuruvai ADT-27</i> |                           |                     |                  |                   |                   |                   |                  |                   |                   |                   |                   |
| 1.                    | OLS<br>(Unrestricted)     | —                   | 5.961<br>(0.379) | 0.219<br>(0.241)  | 0.768<br>(0.206)  | -0.233<br>(0.102) | 1.134<br>(0.081) | 0.003<br>(0.053)  | -0.229<br>(0.048) | -0.464<br>(0.073) | -0.198<br>(0.063) |
| 2.                    | Zellner<br>(Unrestricted) | —                   | 6.033<br>(0.237) | 0.464<br>(0.149)  | 0.499<br>(0.127)  | -0.145<br>(0.063) | 1.025<br>(0.050) | -0.002<br>(0.033) | -0.229<br>(0.048) | -0.464<br>(0.073) | -0.198<br>(0.063) |
| 3.                    | Zellner<br>(Restricted)   | F(3,483)<br>= 40.74 | 8.177<br>(0.262) | -0.038<br>(0.035) | -0.165<br>(0.052) | 0.055<br>(0.045)  | 1.002<br>(0.082) | -0.034<br>(0.054) | -0.038<br>(0.035) | -0.165<br>(0.052) | 0.055<br>(0.045)  |
| <i>Samba CO 25</i>    |                           |                     |                  |                   |                   |                   |                  |                   |                   |                   |                   |
| 1.                    | OLS<br>(Unrestricted)     | —                   | 8.855<br>(1.680) | -1.806<br>(0.973) | 0.541<br>(0.401)  | -0.316<br>(0.190) | 0.998<br>(0.162) | 0.010<br>(0.130)  | -0.318<br>(0.057) | -0.603<br>(0.099) | -0.227<br>(0.048) |
| 2.                    | Zellner<br>(Unrestricted) | —                   | 7.808<br>(1.570) | -0.950<br>(0.909) | 0.549<br>(0.374)  | -0.570<br>(0.178) | 0.984<br>(0.151) | -0.007<br>(0.121) | -0.318<br>(0.057) | -0.603<br>(0.099) | -0.227<br>(0.048) |
| 3.                    | Zellner<br>(Restricted)   | F(3,423)<br>= 4.61  | 8.716<br>(0.538) | -0.313<br>(0.054) | -0.575<br>(0.094) | -0.224<br>(0.046) | 1.009<br>(0.157) | -0.017<br>(0.127) | -0.313<br>(0.054) | -0.575<br>(0.094) | -0.224<br>(0.046) |

*Equations*

1. LR PROF 2 =  $\beta_0 + \beta_1$  LRFS WAGE +  $\beta_2$  LRH WAGE +  $\beta_3$  LRBUL PRICE +  $\gamma_1$  L LAND +  $\gamma_2$  L CAP 1
  2. FS LAB 2 =  $b_1$
  3. H LAB 2 =  $b_2$
  4. BUL =  $b_3$
- Notes: 1. Parentheses contain asymptotic standard errors.  
2. Critical values of F distribution: 5% F (3,400) = 2.62, F (3,1000) = 2.61 1% F (3,400) = 3.83, F (3,1000) = 3.80.

Thus the stronger test of the restricted profit function model rejects it. In passing, it is worth noting that for these estimates for the Kuruvai and Samba crops, all the signs on variable input prices are wrong except that family and annual servant wage has a correct sign. To summarise these results: even a weak test of 'correct' signs is not met satisfactorily and a stronger test of restrictions on parameter values is rejected.

Thus the results of this section reinforce the results reported in an earlier paper, [Junankar, 1980] in that they reject the simple neo-classical restricted profit function model. In the way this model is set up it allows farmers to consistently under or over-estimate variable input prices and hence not maximise profits perfectly [Lau and Yotopoulos, 1973; Junankar, 1980]. But the results we get with wrong signs on (most) variable input prices imply that farmers do *not* behave in a *consistent maximising* fashion.<sup>11</sup> In my earlier paper I listed several 'alibis', two of which I have tried to take account of in this paper. Here I have extended the paper to allow for more variable inputs (two types of labour and Bullock labour) and made a small attempt to allow for the timing of the human labour. For the kind of agricultural operations carried out in this region, human labour and bullock labour are the most important variable inputs. The only other important variable input which I have not explicitly allowed for is 'fertilisers and manures'. Data shortcomings mean that I do not have a price for this variable but only its value. This value has been included in the broader definition of capital, which may be a mis-specification as it is not a fixed input. However, alternative results presented in Table 4.2.A.1 suggest that it makes little difference if this variable is excluded.<sup>12</sup> The timing of inputs has been captured to some extent by disaggregating human labour. Admittedly, it is a very crude approximation but data limitations prevent any better way of taking account of this (in my view) important problem. Another possible reason for my negative results mentioned in my earlier paper was the specification of the production function.<sup>13</sup> The most obvious alternative functional form for the production function is the CES. However, with multiple inputs the problem becomes very messy and the estimation complicated. In any case, most of the estimated CES functions give an elasticity of substitution much less than one, which would make the farmers *less* sensitive to real input prices [Nerlove, 1967]. Thus intuition suggests that a CES production function would not improve our results. Within the confines of a neo-classical model there may be other explanations of our negative results, perhaps most importantly the neglect of uncertainty [Roumasset, 1976]. However, it is clear that a simple static model of behaviour under competitive conditions does *not* apply to Indian farmers.

## 4 Conclusions

In this paper I have presented econometric results using data from the Thanjavur district of Tamil Nadu which reject the restricted profit function model. The tests allowed for three variable inputs (family and annual servant

labour, casual hired labour and bullock labour) and two fixed inputs (land and capital). By distinguishing two varieties of labour an attempt was made to capture either the different *timing* of labour or the different qualities of labour (or both timing and quality). However, in spite of this the coefficients on these variables appeared with the wrong signs (except in one case where the coefficient was not significantly different from zero). The only variable to turn up consistently with the correct sign (and significantly different from zero) was land. At the end of the last section we discussed some possible reasons (within the neo-classical paradigm) for those negative results.

Before concluding I shall make a few speculative comments. What we have found is that Indian farmers do not maximise profits *assuming competitive conditions*. Most observers of Indian life would agree that small and large farmers do not operate in the same markets (and they are not competitive) whether it is the credit market or the labour market. Large farmers often have social and political control over agricultural workers and the wages paid may reflect this. A recent revival of Leibenstein's consumption-wage-productivity nexus discusses the payment of an 'efficiency-wage'. That this efficiency-wage hypothesis explains our negative results seems to me unlikely. As Bliss and Stern [1976] observe '[m]any of the local labour markets in India are conducted on a day-to-day basis and the wages paid in different markets vary a great deal. For such markets we conclude that the efficiency wage theory has no strong relevance' [Bliss and Stern, 1976, p. II.46].

To conclude, our results from a relatively prosperous paddy-growing region of India do not support the profit function model. These results reinforce our earlier results from another prosperous wheat-growing region (Ferozepur district of Punjab). It is clear that more research needs to be done to explain the behaviour of farmers in poor countries. Despite some evidence that inputs and outputs respond normally to price changes, a simple neo-classical model of profit maximising behaviour does not work.

## Notes

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1. Notable exceptions are Yotopoulos and Lau, [1973], Sidhu, [1974] and some earlier work by the author, Janankar, [1980].
2. It is also called a variable profit function model, Diewert, [1974].
3. The Cobb-Douglas production function is a 'self dual'. The profit function is also a Cobb-Douglas function.
4. For example, 75 per cent of total family and annual servant labour is used in the peak season and 25 per cent in the slack season. See Nath, [1974].
5. These figures are averages for the years 1967/70 and are taken from FMS Combined Report for Thanjavur, [Ministry of Agriculture, undated].
6. Details can be found in the Ministry of Agriculture FMS Combined Report for Thanjavur district, Tamil Nadu.

7. Note this is a short-run model. In some earlier tests on this model, we allowed for 'neutral' technical differences between small and large farmers (and for owner and tenant farmers). The data rejected this hypothesis. We also tested for differences in price efficiency (equating marginal products to real input prices (see Junankar, [1980]) for small and large farmers. The data rejected this hypothesis as well.
8. It is interesting that casual hired labour which is a more 'flexible' input has a wrong sign, while family and annual servant labour which is less flexible, has a correct sign.
9. Paranthetically, it is worth noting that most of the explanation in the regressions comes from the land variable. The simple correlation coefficient between the two wage rates (as entered in the regressions) was less than 0.1 for each crop.
10. See above for a similar result.
11. Assuming they face given input and output prices.
12. Introducing regional dummies made no difference to the results. A variable to capture the variations in tenancy was also tried, but it did not affect the results significantly.
13. In a letter to me (dated 14 June, 1977) Professor L. J. Lau suggests 'If I had to guess what went wrong, I would say that wrong functional form and variable inputs other than labour were probably responsible for the rejection of the profit maximisation hypothesis'. In some work in progress, I use translog profit functions to test the theory. However, preliminary estimates suggest that even using this flexible functional form, the theory is not supported by the data. These results are presented in Junankar, [1978].

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# 4.3

## Neo-Classical Economics and Indian Agriculture: An Econometric Analysis of Production Behaviour

P. N. Junankar

### I Introduction

The aim of this paper is to test the propositions of neo-classical economic theory using data from Indian agriculture. The paper begins by discussing some of the key assumptions underlying neo-classical economic theory, the propositions derived from it and the policies proposed, based on the theory. To anticipate our conclusions, we find that there is little empirical support for neo-classical economic theory and we therefore require a new 'paradigm' for explaining the production behaviour of farmers in less developed countries.

Some time ago, Schultz (1954) had argued that peasant farmers were 'efficient but poor'. In a recent book, Schultz (1978) argues that farmers 'in dealing with costs, returns and risks, are calculating economic agents. Within their small individual, allocative domain, they are fine-tuning entrepreneurs, tuning so subtly that many experts fail to see how efficient they are ...' (p. 4). This optimising behaviour is presupposed in the agricultural supply response literature (see for example, Nerlove (1979)) and provides the basis for policy prescriptions. Thus policies for improving the performance of the agricultural sector rely on altering prices (e.g. agricultural prices relative to industrial prices) rather than on changing the institutional structure. In a long and detailed analysis of a village in North India (Palanpur), Bliss and Stern (1982) argue that 'a model of the maximisation of the value of output net of the costs of production, where one uses both cash and imputed values [of] costs, is, in general, *inadequate* as an explanation of the behaviour observed'.<sup>1</sup> (p. 304, emphasis added). However, they add, 'a maximisation model, provided one selects an appropriate objective

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[expected utility maximisation] can be successful in explaining the farmers' behaviour.'<sup>1</sup> (p. 304). In contrast to these views are those of the 'institutionalist school': Gunnar Myrdal being the most notable and well known. In *Asian Drama*, Myrdal (1968), argues '... the absence of anything like perfect markets; many transactions are not of the market type at all ... price incentives are weak. Few people calculate in terms of costs and returns and, if they do, their economic behaviour is not primarily determined by such calculations. The masses of people are survival minded' (vol. 2, pp. 912–13).<sup>2</sup>

Neo-classical economic theory is based on individual profit maximising behaviour under (usually) competitive conditions. On this basis we can derive and estimate supply functions of output and demand functions for inputs. Given profit maximising (or even cost minimising behaviour) we can estimate the postulated 'nice' production function. Tests of neo-classical production theory have been usually,

- (i) to estimate output supply functions (or more often acreage response functions) following the pioneering work of Nerlove (1958) and surveyed by Askari and Cummings (1977),
- (ii) to estimate (usually) Cobb-Douglas production functions, Hopper (1965) and
- (iii) to estimate profit functions jointly with input demand functions, Lau and Yotopoulos (1971), Yotopoulos and Lau (1983), Junankar (1980a, 1980b).

The output supply functions or acreage response functions which purport to show the price responsiveness of crops (using aggregate time series data) have often come out with mixed results and are typically estimated with inappropriate methods.<sup>3</sup> Since they use aggregate data, they are only *indirect* tests of the postulated microeconomic profit maximising competitive behaviour. The tests of neo-classical production theory which estimate (usually) Cobb-Douglas production functions and then compare the estimated marginal products (using geometric mean values of outputs and inputs) with the prices of inputs, are of doubtful value for the following reasons. First, most production functions have been estimated by Ordinary Least Squares and therefore the results suffer from simultaneous equation bias: the inputs are *endogenous* variables (not exogenous) and are correlated with the error term. Second, the comparison of a mean marginal product with a mean price ignores the dispersion round the mean (and hence the non maximising behaviour of all but the 'average' farm).<sup>4</sup> Third, (and related to the previous point) no explanation is given for postulating an *identical* production function for all farmers, but *different* vectors of prices.

The most direct test of production behaviour, using micro data, is that proposed by Lau and Yotopoulos (1971, 1973) where they use duality theory

to obtain and estimate profit functions and input demand functions. They allow for differences in technical efficiency ('neutral' differences in production functions) and price efficiency (marginal products equal to a constant times input price). They assume a Cobb-Douglas production function which implies a Cobb-Douglas profit function. In previous work, Junankar (1980a, 1980b), I used a Cobb-Douglas production and profit function and found that the model was rejected by the data. However, it is possible to argue that the reason for rejecting the model was due to the assumption of a restricted functional form. In this paper I use a translog function which provides a second order approximation to any twice differentiable function. Thus these tests are not open to the obvious criticism that the results obtained depend on a special functional form. In fact, the Cobb-Douglas is a special case of the translog so I can test to see whether the results are sensitive to the specification of the functional form. A rejection of the model implies a rejection of the joint hypothesis of maximising behaviour *and* the competitive model. In other words a rejection may be due to non-profit maximising behaviour *and/or* non-competitive markets. We cannot (unfortunately) discriminate between these two reasons for a rejection of the model.<sup>5</sup>

In Section 2, I shall outline the (short-run) variable profit function model, discuss the data in Section 3, present the results of the econometric tests in Section 4 and discuss the shortcomings of the model in Section 5. A final section summarises our findings and concludes with suggestions for further work.

## II The Model

In this section we shall outline the variable profit function approach and discuss the tests that we shall carry out. We assume a *short run, certain, competitive model* with farmers acting as price takers in input and output markets. Assuming that the production possibility set satisfies the usual neo-classical properties (it is a closed, convex, non-empty, mono-tonic and bounded set), short-run profit maximizing behaviour gives us a (variable) profit function in terms of input (and output) prices and the quantities of fixed inputs. From duality theory<sup>6</sup> (Hotelling's lemma) the variable input demand functions are obtained by simply differentiating the profit function. Given a production possibility set T (with the earlier mentioned properties) gives a production function;

$$f(Y_2; X) \equiv \text{Max}_{Y_1} [Y_1 : (Y; X) \in T] \quad \dots (1)$$

or in the usual form as:

$$y_1 = F(Y_2; X) \quad \dots (2)$$

$$\begin{array}{ll}
 \text{where} & y_1 = \text{output} \quad Y_1 \geq 0) \\
 & Y = (y_1 \ y_2 \ \dots \ y_n) \\
 & Y_2 = (y_2 \ \dots \ y_n) \quad (\text{variable inputs; } Y_2 \leq 0) \\
 & X = (x_1 \ x_2 \ \dots \ x_k) \quad (\text{fixed inputs})
 \end{array}$$

maximising short-run profits

$$\text{Max}_Y \Pi = PY \quad \dots (3)$$

$$\text{gives} \quad \Pi = \Pi(P; X) \quad \dots (4)$$

Where  $P = (p_1 \ p_2 \ \dots \ p_n)$  is the price vector corresponding to the  $Y$  vector, with  $p_1$  as output price.

By Hotelling's lemma, differentiating (4) with respect to price gives

$$y_i = \frac{\partial \Pi}{\partial p_i} = y_i(P; X) \quad \dots (5)$$

In some cases if we take an explicit functional form for the production function we can solve for the derived profit function and the input demand functions in terms of the parameters of the production function.<sup>7</sup> The Cobb-Douglas production function is one such case where the profit function and input demand functions are also of Cobb-Douglas forms: they are 'self-duals'. However, if we take a flexible functional form for the production function, this is no longer possible. An alternative is to take a flexible functional form for the profit function (which satisfies certain conditions on the production set) and derive the input demand equations. We shall follow this approach and postulate a translog profit function:

$$\begin{aligned}
 \ln \pi = & \alpha_0 + \sum \alpha_i \ln p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \\
 & + \sum_i \sum_j \delta_{ij} \ln x_i \ln p_j + \sum \beta_j \ln x_j \\
 & + \frac{1}{2} \sum_j \sum_k f_{jk} \ln x_j \ln x_k
 \end{aligned} \quad \dots (6)$$

$$S_i = a_i + \sum_h \gamma_{ih} \ln p_h + \sum_j \delta_{ij} \ln X_j \quad \dots (7)$$

Input Share Equations ( $i=1, \dots, n$ )

Where the symbols are as before and that  $S_i = \frac{p_i Y_i}{\pi}$  (One of the share equations is redundant so we drop the output equation).

For purposes of estimation and testing let us add  $u_1$ , an error term, to equation (6) and rewrite equation (7) as:

$$S_i = a_i + \sum_h g_{ih} \ln p_h + \sum_j d_{ji} \ln X_j + u_i \quad i = (2, \dots, n) \quad \dots (7a)$$



where  $u_i$ 's are error terms.

Economic theory (rational profit-maximising behaviour for competitive farmers) implies the following restrictions:

R1 (*Homogeneity of degree one in all prices*)

- A (i)  $\sum a_i = 1$  (ii)  $\sum_j \delta_{ij} = 0$  for all i  
 (iii)  $\sum_h \gamma_{ih} = 0$  for all i (vi)  $\sum_h g_{ih} = 0$  for all i  
 (v)  $g_{ih} = g_{hi}$  and  $\gamma_{ih} = \gamma_{hi}$  for all i, h (symmetry)  
 B (vi)  $\alpha_i = a_i$  all i Equality across equations  
 (vii)  $\gamma_{ih} = g_{ih}$  all i, h  
 (viii)  $\delta_{ij} = d_{ij}$  and i, j

R2 (*Homogeneity of degree one in X: constant returns to scale*)

R1 plus

- (ix)  $\sum \beta_j = 1$  (x)  $\sum_i \delta_{ij} = 0$  for all j  
 (xi)  $\sum_h \phi_{jh} = 0$  for all j (xii)  $\sum_j \phi_{jh} = 0$  for all h

These are a formidable array of restrictions that economic theory imposes on equations (6) and (7a) within and across equations. We now list the tests of validity and consistency that we carried out. (These are only *necessary* conditions: *sufficient* conditions for convexity cannot be stated in general, we have to look at the estimated values.)

### Test 1

Estimate the set of equations (6) and (7a) subject to R1 and compare with an *unrestricted* estimation using a log-likelihood ratio test. If the data are consistent with the theory then it implies that the model's predictions are not rejected and that the derived input share equations are consistent with the profit function.

### Test 2

Estimate the set of equations to R2 and compare (as above) with an unrestricted estimation. If the data do not reject these restrictions it implies that the profit function is homogeneous of degree one in prices *and* in fixed inputs and that the input share equations are consistent with the profit function.

### Test 3

To test whether the translog function is a mis-specification, when the 'true' function is Cobb-Douglas we tested the following restrictions. (This

is because the Cobb-Douglas is a special case of the translog function). In other words, we are testing for a Cobb-Douglas case with homogeneity in prices and in fixed inputs.

R3

$$\left. \begin{array}{l} \text{(i) } \gamma_{ij} = g_{ij} = 0 \\ \text{(ii) } \delta_{ij} = d_{ij} = 0 \\ \text{(iii) } \phi_{ij} = 0 \end{array} \right\} \text{ for all } i, j$$

$$\begin{array}{l} \text{(iv) } \sum \alpha_i = 1 \\ \text{(v) } \sum \beta_i = 1 \\ \text{(vi) } \alpha_i = a_i \quad \text{for all } i. \end{array}$$

We have assumed that equations (6) and (7a) are stochastic due to entrepreneurial errors in optimisation. We assume that the errors have the usual classical properties, except that we allow for a non-singular covariance matrix of errors across equations. The model was estimated by Zellner's Seemingly Unrelated Regressions method which gives asymptotically efficient estimates. We now turn to the results of our tests using cross-section data (on a farm-level basis) from the Thanjavur district (Tamil Nadu) of India for 1969–70. (The data are described in the next section).

### III The Data

The data for this paper come from The Farm Management Studies for the Thanjavur district of Tamil Nadu (South India) for the year 1969–70. This district is relatively prosperous and benefited from being part of the Intensive Agricultural District programme (I.A.D.P.) of 1960. As a result, farmers have been exposed to new farming methods and new varieties of seeds. The district is fertile, well irrigated (about 85% of net sown area is irrigated) and has a moderate climate. The main crop of this region is Paddy (about 80% of gross cropped area) and, as this is a well irrigated district, three crops are cultivated in a year. The three crop seasons are: Kuruva (June to September), Samba (August to January) and Thaladi (September–October to February–March).

The data are for a stratified random sample of 150 farms (10 farms each from 15 villages) collected for the Indian Ministry of Agriculture and Irrigation (Directorate of Economics and Statistics) by the Farm Management Unit at the University of Madras. In Table 4.3.1 we present a distribution of farms.

As we can see the average farm size is fairly small, 3.06 hectares and the distribution of 'operational holdings' (area owned and *net* area leased in) is very unequal. For example the top 13% cultivate 40% of the land; the bottom 47% cultivate 17% of the land. As mentioned earlier, as this was an

Table 4.3.1 Distribution of farms, cultivated area and average size of farm

| Size of cultivators' holding (Hectares) | Farms |            | Cultivated Area |            | Average size of farm (Hectares) |
|-----------------------------------------|-------|------------|-----------------|------------|---------------------------------|
|                                         | No.   | Percentage | Hectares        | Percentage |                                 |
| Up to 1.16                              | 35    | 23.33      | 25.47           | 5.55       | 0.73                            |
| 1.17-2.02                               | 35    | 23.33      | 54.40           | 11.85      | 1.55                            |
| 2.03-3.05                               | 35    | 23.33      | 87.77           | 19.12      | 2.51                            |
| 3.06-5.71                               | 25    | 16.67      | 105.90          | 23.06      | 4.24                            |
| Above 5.71                              | 20    | 13.34      | 185.59          | 40.42      | 9.28                            |
| All farms                               | 150   | 100.00     | 459.13          | 100.00     | 3.06                            |
| Owners                                  | 77    | 51.33      | 303.17          | 66.03      | 3.94                            |
| Tenants                                 | 28    | 18.67      | 33.35           | 7.26       | 1.19                            |
| Owner-cum-tenants                       | 45    | 30.00      | 122.61          | 26.71      | 2.72                            |

Source: Ministry of Agriculture and Irrigation (1974).

I.A.D.P. region new improved varieties of seeds were used by most farmers.<sup>8</sup> Of the land devoted to Paddy cultivation in the Kuruvai season, most of it (94%) is under the improved variety called ADT 27 and the remainder under the local or *desi* variety. Similarly, for the Samba season, 84% of the land devoted to paddy is under an improved variety called CO25 and the remainder under the local variety. In the Thaladi season, only 42% is under CO25 and the remainder under the local variety. The Samba crop is primarily for self-consumption, unlike the Kuruvai and Thaladi crops which are primarily for sale.<sup>9</sup> During this period there was a 'food grains control order' in force: sales had to be made to Government agents only at fixed prices. Officially, no private trade was allowed although it did take place to some extent. Most farmers used 'improved' methods of cultivation (i. e. used at least two of the following: improved seeds, mechanised implements, fertilisers, pesticides). Besides family labour most farms used casual hired labour during the peak seasons. During peak seasons some of the casual hired labour consisted of migrants from outside the district. A small number of annual farm servants were employed, primarily by the large farmers. Bullock labour was an important source of energy: 130 of the 150 farmers owned at least one pair of bullocks (bullocks include he-buffaloes). It is interesting to compare this situation with one reported by Bliss and Stern (1980) for Palanpur where a market for bullock services did not exist. For the sample used in this study, bullock services were exchanged as well as hired out, mainly by the smaller farmers. For the smallest group of farmers (less than 1.16 hectares) of the total use of bullock labour 22% was hired out.

Having discussed the general characteristics of the sample, I shall test the theory presented in the previous section using the data for the Kuruvai season for ADT27 and for the Samba season for CO25. As all farmers did not cultivate these crops the sample size is different for the two crops. In

addition we had to delete those farms from the sample that had zero or negative values for any variable. This is likely to lead to some (unknown) bias but given a log-linear specification this seemed the best we could do.<sup>10</sup> A detailed list of variables is given in the Appendix.

## IV The Tests

The theory discussed in Section 2 is very tightly specified and the only freedom we have is in specifying the *number* of variable and fixed inputs. The *number* of inputs we specify for the production function is clearly arbitrary (we have to choose some level of aggregation). As regards specifying which inputs are fixed and which variable, we have followed the usual practice. We assume there are only two fixed inputs: land and capital. We assume that there are only three variable inputs: casual hired labour, family and annual servant labour, and bullock labour services. These are all measured as flows: day of labour services used in that year. The breakdown of human labour into two categories can be justified on three alternative counts: (i) differences in timing, or (ii) different activities performed by the two kinds of labour, or (iii) qualitative differences. Casual hired labour is used only in the peak agricultural seasons, while family and annual servant labour is spread over the entire crop season. Ideally we would like to have dated labour inputs but the data were not available. We assume therefore that family and annual servant labour is used in fixed proportions in the peak and slack seasons. Casual hired labour is employed for specific activities e. g. digging, weeding, transplanting paddy, harvesting, while family and annual servant labour is used (in addition to the above activities) for general maintenance, irrigation, etc. It is sometimes argued that family labour would provide more 'loving care' to the land unlike casual hired labour. These alternative justifications for using two categories of labour are not mutually exclusive: a combination of the three reasons may mark it a sensible distinction.

An important variable input we had to exclude from our model (due to the lack of a price series for it) was fertilizer inputs. A poor alternative was to include it in the 'capital' variable (see Appendix 4.3.1 for details). In an earlier study it was found that inclusion or exclusion of fertilizers in the definition of capital did not affect the general nature of the results.<sup>11</sup>

As this is a short-run model, the fixed inputs are predetermined variables and the variable input and output prices are (by assumption) exogenous. As such we encounter no simultaneous equation bias when we estimate equations (6) and (7a) by Zellner's Seemingly Unrelated Regressions method. This method gives asymptotically efficient results. The data used are for the paddy crops in 1969–70 for the Kuruvai season using ADT-27 seeds and the Samba season using CO25 seeds.

Because of the nature of the translog function there are no simple sign restrictions on the parameters. As the number of estimated parameters is so large, and because a number of restrictions are imposed a 'visual scanning'

Table 4.3.2 Translog profit functions: tests of restrictions

| Test | $\chi^2$ for ADT 27 | $\chi^2$ for Samba<br>CO25 | Restrictions | Critical (5%) | Value $\chi^2$ (1%) |
|------|---------------------|----------------------------|--------------|---------------|---------------------|
| 1    | 99.62               | 96.98                      | 28           | 41.34         | 48.28               |
| 2    | 102.47              | 120.59                     | 34           | 48.57         | 56.01               |
| 3    | 211.70              | 131.31                     | 44           | 60.46         | 68.67               |

of the results does not seem very helpful. As such we present the detailed results in Appendix 4.3.2. The model is estimated subject to the restrictions and a log likelihood ratio (which is distributed as a chi-square) is used to test the restriction.<sup>12</sup> These tests of restrictions are presented in Table 4.3.2.

For both crops the data reject (at the 1% level) Tests 1 and 2. In other words the profit function and share equations do *not* satisfy the restrictions imposed by the theory. Finally, in Test 3 we reject the Cobb-Douglas profit (and hence production) function specification (with homogeneity in prices and *all* inputs) for both crops. Thus overall, our results suggest that the neo-classical profit maximising model under competitive conditions is rejected. As the translog function is a flexible functional form it implies that the theory is rejected not because of a restrictive functional form but because some (or all) of the neo-classical assumptions are not valid.

## V Some Problems

In this section I shall discuss some of the factors that might explain why we have rejected the neo-classical profit maximising model. I shall discuss these under three heads: (a) data problems, (b) uncertainty, (c) institutional constraints.

### (a) Data Problems

A possible explanation may be that we have poor or inaccurate data, i.e. we have measurement errors. But as we discussed in Section 3 the data have been collected for a stratified random sample on a fairly rigorous basis with university trained research staff. Parenthetically it is worth remarking that similar data have been used by other investigators to estimate production functions etc., where formal tests of economic theory were not carried out. A similar objection is to the specification of the inputs in our study. Given the data it seems we have done as well as possible. In previous work alternative definitions of inputs and outputs did not give significantly different results. An important objection may be that our *aggregation over time* may have led to these 'peculiar' results. However, data do not exist on a monthly basis and even if it did, we would find that the numbers of parameters to be estimated would be too large to handle. In addition, with a log-linear specification, since many variables would have zero values, we could not estimate such a function. (See below under 'Institutional Constraints')

### (b) Uncertainty

It is possible to argue that a 'proper' specification of a 'neo-classical' model should be one including uncertainty. Some attempts have been made to model agricultural decision under uncertainty for some *special* cases. For example, Bliss and Stern (1980) show that if risk averse farmers are maximising *expected utility* subject to *production* uncertainty, then, in general the ratio of marginal value products (MVP), to input price (P) would be different for different inputs. For *multiplicative* production uncertainty, the ratio of MVP to P would be the same for all inputs. In their study of Palanpur they explain the excess of MVPs over input prices by very risk averse farmers producing under uncertainty and due to the non-perfect credit market. However, they simply estimate some production-cum-behavioural relationships (linear or log-linear) and do not carry out formal tests of consistency of input demand functions with profit or production functions. Given our framework, multiplicative production uncertainty should not affect our tests of consistency (equality of coefficients over equations).<sup>13</sup> We, therefore, feel that the introduction of uncertainty of this particular type would not alter our results. However, a 'realistic' model must include not only production uncertainty but uncertainty about input and (especially) output price. Even production uncertainty is to some extent under the control of the farmer by using appropriate inputs (e. g. pesticides, controlled irrigation and drainage of lands, etc.) as well as better *timing* of inputs, like sowing, fertilisers, irrigation etc. These are important problems that we have had to ignore, partly due to data inadequacies but, more importantly, due to an absence of a model that is susceptible to estimation and testing.

### (c) Institutional Constraints

In recent years some authors, e. g. Bhaduri (1973), Bharadwaj (1974), have argued that the simple neo-classical view of peasants responding *solely* to price signals is misleading and/or wrong. They argue that in peasant agriculture markets are inter-linked by *non-price methods*. For example, a decision by a peasant to lease in land (or taking credit) 'locks' him into selling output only to the landlord and providing labour services to the landlord. In this scenario peasants face *person-specific* prices and often have quantity constraints imposed as well.<sup>14</sup> Unfortunately, our data do not allow us to investigate these issues directly. However, it is clear from our data that the incidence of tenancy is fairly high (21.64% of total operated area is leased in land) and, as such, we would expect some institutional constraints on these tenants.

However, we can try to study these institutional constraints by indirect methods. We shall study them by looking at some of the data we have on output sales, the credit market and the inputs used.<sup>15</sup> The first important point to note is that small and large farmers do not face the same output price. Small farmers have no storage facility and therefore sell most of their output immediately after the harvest, i. e. at the lowest (seasonal) price. They then have

to purchase rice for consumption prior to the next harvest, i.e. at the highest prices. Large farmers, who have better storage facilities, spread their sales out over the year and hence get better prices.<sup>16</sup> Another important feature is that small and large farmers sell their output to *different* buyers. Although sales to non-Governmental agents or agencies were prohibited, some private trade did take place. For example, very small farmers (less than 1.16 hectares) sold 7.9% of their total sales to other cultivators while large farmers (greater than 5.71 hectares) sold 26.8% of their total sales to other cultivators. (These sales were, strictly speaking, illegal!)<sup>17</sup> To what extent these transactions were 'tied' due to entering a contract in some other market is not known.

If we look at the credit market it is clear that there are institutional constraints that prevent small farmers from getting loans, or loans at the lower interest rates that large farmers borrow. Table 4.3.3 sets out the details.

As shown in Table 4.3.3, small farmers obtained a higher proportion of their loans from money lenders, while larger farmers obtained a very high proportion of their loans from the banks or the Government. The Government cooperatives and banks provided loans at lower rates of interest than the others. Of the 141 loans taken, 66 (47% of the loans) were at interest rates between 6% and 10%, and 35 (25% of the loans) were at interest rates *above* 24%! It is clear from the table that the credit market is far from perfect! Loans were primarily taken by small farmers for 'normal agricultural operations' (buying seeds, fertilisers, etc.). The next most important

Table 4.3.3 Amounts in rupees borrowed (per cent of total amount borrowed) – sources of Loans (1969/70)

| Agencies          | Up to<br>1.16 h | 1.17 to<br>2.02 h | 2.03 to<br>3.05 h | 3.06 to<br>5.71 h | Above<br>5.71 h  | All Farms        |
|-------------------|-----------------|-------------------|-------------------|-------------------|------------------|------------------|
| Money lenders     | 2765<br>(26.31) | 3400<br>(28.52)   | 9000<br>(20.17)   | 6000<br>(15.99)   | 7000<br>(6.59)   | 28165<br>(13.37) |
| Co-op Society     | 1630<br>(15.51) | 1250<br>(10.49)   | 4350<br>(9.75)    | 6460<br>(17.21)   | 8700<br>(8.20)   | 22390<br>(10.63) |
| Panchyat Union    | 500<br>(4.76)   | 250<br>(2.10)     | 500<br>(1.12)     | 259<br>(0.67)     | 3650<br>(3.43)   | 5150<br>(2.44)   |
| Relatives/Friends | 2410<br>(22.93) | 6520<br>(54.70)   | 12400<br>(27.80)  | 700<br>(1.87)     | 900<br>(0.85)    | 22930<br>(10.80) |
| Others            | 1675<br>(15.94) | —                 | 12100<br>(27.12)  | —                 | —                | 13775<br>(6.54)  |
| Private           | 700<br>(6.66)   | —                 | 4300<br>(9.64)    | 4000<br>(10.66)   | 28500<br>(26.85) | 37500<br>(17.80) |
| Banks             | 830<br>(7.89)   | 500<br>(4.19)     | 761<br>(1.71)     | 19786<br>(52.73)  | 3000<br>(2.83)   | 24877<br>(11.80) |
| Govt.             | —               | —                 | 1200<br>(2.69)    | 330<br>(0.87)     | 54400<br>(51.25) | 55930<br>(26.54) |
| Total             | 10510<br>(100%) | 11920<br>(100%)   | 44611<br>(100%)   | 37535<br>(100%)   | 106150<br>(100%) | 210717<br>(100%) |

Source: Ministry of Agriculture & Irrigation (1974) Table 3.37, 3.58.

reason for loans was for 'Social Expenditure' (for marriages and religious festivals). Large farmers took out loans to purchase farm implements, land and, for agricultural operations and social expenditure.<sup>18</sup>

Input markets for human labour and bullock labour show characteristics which suggest 'imperfections' which may be due to institutional constraint. For example, family workers were unemployed for 47% of the year (assuming a 365-days year and counting 8 hour working days) with the remainder of the time spent on farm production, hired out labour, 'family and social' etc<sup>19</sup> The smallest size group of farmers hire out more of their labour (31% of their working year) while the largest do not hire out *any* labour. For bullock labour, small farmers hire out more than large farmers, even though 'unemployment' (based on 8 hour bullock pair days for 365 days) was 80%. Employment of bullock *includes* 'social and family' work. How can we explain this massive unemployment without resorting to institutional constraints? In the off-peak seasons human and bullock labour could be used to improve irrigation, drainage etc.

All these institutional constraints suggest that a simple neo-classical profit maximising model is inappropriate and that our formal tests reject the model is not surprising.

## VI Summary and Conclusions

I began this paper by setting out the competing views of the neoclassical school and the institutional school. In Section 2, I outlined the neo-classical variable profit function model, outlined my sample data in Section 3 and tested the model in Section 4, using Zellner's Seemingly Unrelated estimation method. The results *conclusively* rejected the theory. In Section 5, I discussed various problems, data measurement problems, problems when we introduce uncertainty in the model and finally, various institutional constraints which suggest the inappropriateness of the neoclassical model.

Having rejected the simple neo-classical model we now have to think of alternative models, or alternative model specifications. We do *not* mean to argue that Indian farmers are not motivated by economic incentives. It is clear to the casual observer of Indian village life that input and output markets are not perfect. The choices available to the small peasant farmer are quite different to that faced by the medium to large farmers who have no 'survival' problems. For the small peasant farmers we have to model the institutional constraints which limit his choice where he is more concerned with 'survival' rather than maximising some sophisticated objective function. Unless we can construct a model that captures the essential asymmetry of economic relationships in rural agriculture we shall be unable to explain the production and market behaviour of farmers. Much more needs to be done before we can have a general theory of peasant behaviour.



## Appendix I

### List of Variables

1. LX1 = LOG (Area under crop, hectares)
2. LX2 = LOG (Capital  $\equiv$  Depreciation on Implements+Interest on Fixed and Working Capital+Value of Seeds, Manures, Fertilizers and Pesticides)
3. LP1 = LOG (Price of Main Product)
4. LP2 = LOG (Imputed daily wage rate for family and annual servant labour)
5. LP3 = LOG (Casual Hired wage rate per day)
6. LP4 = LOG (Bullock Labour price per day)
7. PYE = (Value of Main Product—actual and imputed human labour costs—actual and imputed bullock labour costs)
8. LPYE = LOG (PYE)
9. S2 = - (Actual and Imputed total costs for Family and Annual Servant Labour  $\div$  PYE)
10. S3 = - (Total costs for Casual Hired labour  $\div$  PYE)
11. S4 = - (Actual and Imputed total costs for bullock labour  $\div$  PYE)

Note: All logarithms are to the base e.

Table 4.3.A.1 Kuruvai ADT27: Unrestricted estimates (Standard errors in parentheses)

|          | LPYE                | S2                | S3                | S4                |
|----------|---------------------|-------------------|-------------------|-------------------|
| Constant | -0.621<br>(15.306)  | 0.731<br>(0.840)  | 0.413<br>(1.308)  | 0.727<br>(1.121)  |
| LP1      | -21.411<br>(17.657) | 0.118<br>(0.220)  | 0.034<br>(0.342)  | 0.126<br>(0.293)  |
| LP2      | -7.895<br>(10.661)  | -0.706<br>(0.440) | -0.757<br>(0.685) | -0.553<br>(0.587) |
| LP3      | -1.450<br>(4.592)   | 0.268<br>(0.267)  | 0.180<br>(0.415)  | 0.194<br>(0.356)  |
| LP4      | -1.752<br>(2.485)   | -0.263<br>(0.110) | -0.422<br>(0.171) | -0.451<br>(0.146) |
| LP1LP1   | 2.761<br>(1.771)    |                   |                   |                   |
| LP1LP2   | -6.272<br>(10.249)  |                   |                   |                   |
| LP1LP3   | 6.132<br>(2.946)    |                   |                   |                   |
| LP1LP4   | -2.695<br>(3.384)   |                   |                   |                   |
| LP2LP2   | -1.235<br>(2.869)   |                   |                   |                   |
| LP2LP3   | 4.478<br>(2.451)    |                   |                   |                   |
| LP2LP4   | -0.159<br>(0.713)   |                   |                   |                   |
| LP3LP3   | 0.578<br>(0.758)    |                   |                   |                   |

(continued)

Table 4.3.A.1 Continued

|        | LPYE              | S2                | S3                | S4                |
|--------|-------------------|-------------------|-------------------|-------------------|
| LP3LP4 | 0.287<br>(0.523)  |                   |                   |                   |
| LP4LP4 | -0.152<br>(0.099) |                   |                   |                   |
| LX1LP1 | -3.765<br>(3.275) |                   |                   |                   |
| LX1LP2 | -1.252<br>(0.938) |                   |                   |                   |
| LX1LP3 | -0.259<br>(0.419) |                   |                   |                   |
| LX1LP4 | 0.113<br>(0.159)  |                   |                   |                   |
| LX2LP1 | 4.400<br>(2.740)  |                   |                   |                   |
| LX2LP2 | 0.024<br>(0.806)  |                   |                   |                   |
| LX2LP3 | 0.131<br>(0.422)  |                   |                   |                   |
| LX2LP4 | -0.091<br>(0.156) |                   |                   |                   |
| LX1    | -0.187<br>(2.953) | 0.289<br>(0.128)  | 0.317<br>(0.199)  | 0.324<br>(0.170)  |
| LX2    | 1.740<br>(2.945)  | -0.091<br>(0.113) | -0.052<br>(0.175) | -0.082<br>(0.150) |
| LX1LX1 | -0.107<br>(1.873) |                   |                   |                   |
| LX1LX2 | 0.218<br>(0.334)  |                   |                   |                   |
| LX2LX2 | 0.098<br>(0.165)  |                   |                   |                   |

Table 4.3.A.2 Kuruvai ADT27: Test 1 (Standard errors in parentheses)

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
|          | 6.289<br>(6.933)  | 0.376<br>(0.532)  | -0.183<br>(0.823) | 0.279<br>(0.657)  |
| LP1      | 0.527<br>(1.890)  | -0.147<br>(0.052) | -0.297<br>(0.070) | -0.140<br>(0.063) |
| LP2      | 0.376<br>(0.532)  | -0.269<br>(0.114) | 0.213<br>(0.047)  | 0.068<br>(0.035)  |
| LP3      | -0.183<br>(0.823) | 0.213<br>(0.047)  | -0.011<br>(0.118) | 0.090<br>(0.038)  |

(continued)

Table 4.3.A.2 Continued

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
| LP4      | 0.279<br>(0.657)  | 0.068<br>(0.035)  | 0.090<br>(0.038)  | -0.035<br>(0.051) |
| LP1LP1   | 0.585<br>(0.097)  |                   |                   |                   |
| LP1LP2   | -0.147<br>(0.052) |                   |                   |                   |
| LP1LP3   | -0.297<br>(0.070) |                   |                   |                   |
| LP1LP4   | -0.140<br>(0.063) |                   |                   |                   |
| LP2LP2   | -0.134<br>(0.057) |                   |                   |                   |
| LP2LP3   | 0.213<br>(0.047)  |                   |                   |                   |
| LP2LP4   | 0.068<br>(0.035)  |                   |                   |                   |
| LP3LP3   | -0.006<br>(0.059) |                   |                   |                   |
| LP3LP4   | 0.090<br>(0.038)  |                   |                   |                   |
| LP4LP4   | -0.018<br>(0.026) |                   |                   |                   |
| LX1LP1   | -0.431<br>(0.361) |                   |                   |                   |
| LX1LP2   | 0.163<br>(0.100)  |                   |                   |                   |
| LX1LP3   | 0.118<br>(0.156)  |                   |                   |                   |
| LX1LP4   | 0.150<br>(0.124)  |                   |                   |                   |
| LX2LP1   | 0.321<br>(0.328)  |                   |                   |                   |
| LX2LP2   | -0.118<br>(0.091) |                   |                   |                   |
| LX2LP3   | -0.094<br>(0.141) |                   |                   |                   |
| LX2LP4   | -0.109<br>(0.113) |                   |                   |                   |
| LX1      | -0.717<br>(2.230) | 0.163<br>(0.100)  | 0.118<br>(0.156)  | 0.150<br>(0.124)  |
| LX2      | 0.463<br>(2.223)  | -0.118<br>(0.091) | -0.094<br>(0.141) | -0.109<br>(0.113) |
| LX1LX1   | -0.223<br>(0.204) |                   |                   |                   |
| LX1LX2   | 0.192<br>(0.362)  |                   |                   |                   |
| LX2LX2   | 0.003<br>(0.183)  |                   |                   |                   |

Table 4.3.A.3 Kuruvai ADT27: Test 2 (Standard errors in parentheses)

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
|          | 6.865<br>(2.460)  | 0.312<br>(0.009)  | -0.273<br>(0.791) | 0.146<br>(0.637)  |
| LP1      | 0.816<br>(1.835)  | -0.138<br>(0.048) | -0.269<br>(0.066) | -0.153<br>(0.054) |
| LP2      | 0.312<br>(0.509)  | -0.272<br>(0.104) | 0.194<br>(0.043)  | 0.080<br>(0.031)  |
| LP3      | -0.273<br>(0.791) | 0.194<br>(0.043)  | -0.015<br>(3.114) | 0.083<br>(0.033)  |
| LP4      | 0.146<br>(0.637)  | 0.080<br>(0.031)  | 0.083<br>(0.033)  | -0.020<br>(0.042) |
| LP1LP1   | 0.560<br>(0.093)  |                   |                   |                   |
| LP1LP2   | -0.138<br>(0.048) |                   |                   |                   |
| LP1LP3   | -0.269<br>(0.066) |                   |                   |                   |
| LP1LP4   | -0.153<br>(0.054) |                   |                   |                   |
| LP2LP2   | -0.136<br>(0.052) |                   |                   |                   |
| LP2LP3   | 0.194<br>(0.043)  |                   |                   |                   |
| LP2LP4   | 0.080<br>(0.031)  |                   |                   |                   |
| LP3LP3   | -0.008<br>(0.057) |                   |                   |                   |
| LP3LP4   | 0.083<br>(0.033)  |                   |                   |                   |
| LP4LP4   | -0.010<br>(0.021) |                   |                   |                   |
| LX1LP1   | -0.254<br>(0.318) |                   |                   |                   |
| LX1LP2   | 0.100<br>(0.087)  |                   |                   |                   |
| LX1LP3   | 0.069<br>(0.135)  |                   |                   |                   |
| LX1LP4   | 0.254<br>(0.110)  |                   |                   |                   |
| LX2LP1   | 0.254<br>(0.318)  |                   |                   |                   |
| LX2LP2   | -0.100<br>(0.087) |                   |                   |                   |
| LX2LP3   | -0.069<br>(0.135) |                   |                   |                   |

(continued)

Table 4.3.A.3 Continued

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
| LX2LP4   | -0.086<br>(0.110) |                   |                   |                   |
| LX1      | 0.678<br>(0.431)  | 0.100<br>(0.087)  | 0.069<br>(0.135)  | 0.086<br>(0.110)  |
| LX2      | 0.322<br>(0.431)  | -0.100<br>(0.087) | -0.069<br>(0.135) | -0.086<br>(0.110) |
| LX1LX1   | 0.006<br>(0.008)  |                   |                   |                   |
| LX1LX2   | -0.006<br>(0.008) |                   |                   |                   |
| LX2LX2   | 0.006<br>(0.008)  |                   |                   |                   |

Table 4.3.A.4 Kuruvai ADT27: Test 3

| Constant | LPYE              | S2                | S3                | S4               |
|----------|-------------------|-------------------|-------------------|------------------|
|          | 7.752<br>(0.700)  | -0.053<br>(0.037) | -0.182<br>(0.057) | 0.038<br>(0.048) |
| LP1      | 1.197<br>(0.138)  |                   |                   |                  |
| LP2      | -0.053<br>(0.037) |                   |                   |                  |
| LP3      | -0.182<br>(0.057) |                   |                   |                  |
| LP4      | 0.038<br>(0.048)  |                   |                   |                  |
| LX1      | 0.934<br>(0.118)  |                   |                   |                  |
| LX2      | 0.066<br>(0.118)  |                   |                   |                  |

NB.: The remaining parameters were constrained to equal zero.

Table 4.3.A.5 Samba CO25: Unrestricted estimates (Standard errors in parentheses)

| Constant | LPYE                | S2                | S3                | S4                |
|----------|---------------------|-------------------|-------------------|-------------------|
|          | 66.489<br>(28.960)  | 0.153<br>(1.190)  | 0.078<br>(1.849)  | 0.342<br>(1.605)  |
| LP1      | 100.362<br>(34.620) | -0.663<br>(0.940) | -0.891<br>(1.461) | -0.632<br>(1.268) |
| LP2      | -14.149<br>(26.539) | -0.308<br>(0.698) | -0.604<br>(1.085) | -0.304<br>(0.942) |

(continued)

Table 4.3.A.5 Continued

| Constant | LPYE                | S2                | S3                | S4                |
|----------|---------------------|-------------------|-------------------|-------------------|
| LP3      | -3.805<br>(8.093)   | -0.162<br>(0.340) | -0.324<br>(0.529) | -0.115<br>(0.459) |
| LP4      | -4.792<br>(3.270)   | 0.199<br>(0.102)  | 0.324<br>(0.159)  | 0.265<br>(0.138)  |
| LP1LP1   | 22.147<br>(6.601)   |                   |                   |                   |
| LP1LP2   | -57.410<br>(21.275) |                   |                   |                   |
| LP1LP3   | 6.936<br>(8.454)    |                   |                   |                   |
| LP1LP4   | -1.159<br>(2.272)   |                   |                   |                   |
| LP2LP2   | -12.267<br>(7.823)  |                   |                   |                   |
| LP2LP3   | 2.178<br>(5.444)    |                   |                   |                   |
| LP2LP4   | -0.221<br>(1.346)   |                   |                   |                   |
| LP3LP3   | 1.649<br>(1.188)    |                   |                   |                   |
| LP3LP4   | 0.077<br>(0.887)    |                   |                   |                   |
| LP4LP4   | 0.078<br>(0.097)    |                   |                   |                   |
| LX1LP1   | 7.498<br>(3.101)    |                   |                   |                   |
| LX1LP2   | 2.360<br>(1.799)    |                   |                   |                   |
| LX1LP3   | -1.612<br>(0.759)   |                   |                   |                   |
| LX1LP4   | -0.603<br>(0.267)   |                   |                   |                   |
| LX2LP1   | -6.152<br>(3.482)   |                   |                   |                   |
| LX2LP2   | -1.162<br>(1.970)   |                   |                   |                   |
| LX2LP3   | 0.645<br>(0.813)    |                   |                   |                   |
| LX2LP4   | 0.703<br>(0.294)    |                   |                   |                   |
| LX1      | 9.027<br>(2.793)    | -0.062<br>(0.107) | -0.085<br>(0.166) | 0.067<br>(0.144)  |
| LX2      | -7.161<br>(3.356)   | -0.067<br>(0.107) | -0.046<br>(0.166) | -0.108<br>(0.144) |

(continued)

Table 4.3.A.5 Continued

| Constant | LPYE              | S2 | S3 | S4 |
|----------|-------------------|----|----|----|
| LX1LX1   | 0.253<br>(0.103)  |    |    |    |
| LX1LX2   | -0.519<br>(0.188) |    |    |    |
| LX2LX2   | 0.286<br>(0.110)  |    |    |    |

Table 4.3.A.6 Samba CO25: Test 1 (Standard errors in Parentheses)

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
|          | 19.319<br>(5.430) | -0.765<br>(0.687) | -1.351<br>(1.052) | -0.970<br>(0.878) |
| LP1      | 4.086<br>(2.531)  | -0.459<br>(0.210) | -0.593<br>(0.295) | -0.654<br>(0.247) |
| LP2      | -4.765<br>(0.687) | 0.130<br>(0.150)  | 0.196<br>(0.108)  | 0.198<br>(0.079)  |
| LP3      | -1.351<br>(1.052) | 0.196<br>(0.108)  | 0.149<br>(0.205)  | 0.322<br>(0.122)  |
| LP4      | -0.970<br>(0.878) | 0.198<br>(0.079)  | 0.322<br>(0.122)  | 0.268<br>(0.106)  |
| LP1LP1   | 1.706<br>(0.725)  |                   |                   |                   |
| LP1LP2   | -0.459<br>(0.210) |                   |                   |                   |
| LP1LP3   | -0.593<br>(0.295) |                   |                   |                   |
| LP1LP4   | -0.654<br>(0.247) |                   |                   |                   |
| LP2LP2   | 0.065<br>(0.075)  |                   |                   |                   |
| LP2LP3   | 0.196<br>(0.108)  |                   |                   |                   |
| LP2LP4   | 0.198<br>(0.079)  |                   |                   |                   |
| LP3LP3   | 0.075<br>(0.103)  |                   |                   |                   |
| LP3LP4   | 0.322<br>(0.122)  |                   |                   |                   |
| LP4LP4   | 0.134<br>(0.053)  |                   |                   |                   |
| LX1LP1   | 0.394<br>(0.364)  |                   |                   |                   |
| LX1LP2   | -0.108<br>(0.095) |                   |                   |                   |

(continued)

Table 4.3.A.6 Continued

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
| LX1LP3   | -0.158<br>(0.148) |                   |                   |                   |
| LX1LP4   | -0.128<br>(0.128) |                   |                   |                   |
| LX2LP1   | 0.035<br>(0.373)  |                   |                   |                   |
| LX2LP2   | -0.020<br>(0.097) |                   |                   |                   |
| LX2LP3   | 0.027<br>(0.152)  |                   |                   |                   |
| LX2LP4   | -0.042<br>(0.131) |                   |                   |                   |
| LX1      | 5.529<br>(1.429)  | -0.108<br>(0.095) | -0.158<br>(0.148) | -0.128<br>(0.128) |
| LX2      | -3.506<br>(1.606) | -0.020<br>(0.097) | 0.027<br>(0.152)  | -0.042<br>(0.131) |
| LX1LX1   | 0.319<br>(0.116)  |                   |                   |                   |
| LX1LX2   | -0.599<br>(0.228) |                   |                   |                   |
| LX2LX2   | 0.310<br>(0.134)  |                   |                   |                   |

Table 4.3.A.7 Samba CO25: Test 2 (Standard errors in parentheses)

| Constant | LPYE                | S2                | S3                | S4                |
|----------|---------------------|-------------------|-------------------|-------------------|
|          | 66.489<br>(28.960)  | 0.153<br>(1.190)  | 0.078<br>(1.849)  | 0.342<br>(1.605)  |
| LP1      | 100.362<br>(34.620) | -0.663<br>(0.940) | -0.891<br>(1.461) | -0.632<br>(1.268) |
| LP2      | -14.149<br>(26.539) | -0.308<br>(0.698) | -0.604<br>(1.085) | -0.304<br>(0.942) |
| LP3      | -3.805<br>(8.093)   | -0.162<br>(0.340) | -0.324<br>(0.529) | -0.115<br>(0.459) |
| LP4      | -4.792<br>(3.270)   | 0.199<br>(0.102)  | 0.324<br>(0.159)  | 0.265<br>(9.138)  |
| LP1LP1   | 22.147<br>(6.601)   |                   |                   |                   |
| LP1LP2   | -57.410<br>(21.275) |                   |                   |                   |
| LP1LP3   | 6.936<br>(8.854)    |                   |                   |                   |
| LP1LP4   | -1.159<br>(2.272)   |                   |                   |                   |
| LP2LP2   | -1.227<br>(7.823)   |                   |                   |                   |
| LP2LP3   | 2.178<br>(5.444)    |                   |                   |                   |

(continued)



Table 4.3.A.7 Continued

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
| LP2LP4   | -0.221<br>(1.346) |                   |                   |                   |
| LP3LP3   | 1,649<br>(1.188)  |                   |                   |                   |
| LP3LP4   | 0.077<br>(0.887)  |                   |                   |                   |
| LP4LP4   | 0.078<br>(0.097)  |                   |                   |                   |
| LX1LP1   | 7.498<br>(3.101)  |                   |                   |                   |
| LX1LP2   | 2.360<br>(1.799)  |                   |                   |                   |
| LX1LP3   | -1.612<br>(0.759) |                   |                   |                   |
| LX1LP4   | -0.603<br>(0.267) |                   |                   |                   |
| LX2LP1   | -6.152<br>(3.482) |                   |                   |                   |
| LX2LP2   | -1.162<br>(1.970) |                   |                   |                   |
| LX2LP3   | 0.645<br>(0.813)  |                   |                   |                   |
| LX2LP4   | 0.703<br>(0.294)  |                   |                   |                   |
| LX1      | 9.027<br>(2.793)  | -0.062<br>(0.107) | -0.085<br>(0.166) | -0.067<br>(0.144) |
| LX2      | -7.161<br>(3.356) | -0.067<br>(0.107) | -0.046<br>(0.166) | -0.108<br>(0.144) |
| LX1LX1   | 0.253<br>(0.103)  |                   |                   |                   |
| LX1LX2   | -0.519<br>(0.188) |                   |                   |                   |
| LX2LX2   | 0.286<br>(0.110)  |                   |                   |                   |

Table 4.3.A.8 Samba CO25: Test 3

| Constant | LPYE              | S2                | S3                | S4                |
|----------|-------------------|-------------------|-------------------|-------------------|
|          | 8.581<br>(0.794)  | -0.189<br>(0.050) | -0.407<br>(0.078) | -0.161<br>(0.067) |
| LP1      | 1.757<br>(0.192)  |                   |                   |                   |
| LP2      | -0.189<br>(0.050) |                   |                   |                   |
| LP3      | -0.407<br>(0.078) |                   |                   |                   |
| LP4      | -0.161<br>(0.067) |                   |                   |                   |

(continued)

Table 4.3.A.8 Continued

| Constant | LPYE              | S2 | S3 | S4 |
|----------|-------------------|----|----|----|
| LX1      | 1.066<br>(0.131)  |    |    |    |
| LX2      | -0.066<br>(0.131) |    |    |    |

NB: The remaining parameters were constrained equal to zero.

## Notes

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1. Compare with their statement, Ch. 8 p. 291. '[T]hus we are unable to confirm that neo-classical economics is alive and well and residing in Palanpur, at least in its simple form.'
2. Also see Simon, (1979) who argues against maximising neo-classical models.
3. See Askari and Cummings (1977) for a survey of the literature.
4. See Rudra, (1973).
5. Compare with Rosenzweig (1980) who looks at the labour supply decisions of households and finds his data support the neo-classical competitive model. However, he uses a one equation model and cannot test for symmetry and consistency.
6. For details, see Diewert (1974).
7. See Yotopoulos and Lau (1973) for a detailed derivation of the Cobb-Douglas case.
8. These varieties have been called 'High Yielding Varieties' but are more appropriately called 'improved'.
9. Thus if neo-classical theory is applicable, it should *at least* be valid for the Kuruvai crop.
10. See Maddala (1977) pp. 201-07 where he discusses some alternatives to the one we chose.
11. These results are presented in Junankar (1980a, 1980b).
12. I am grateful to Jim Richmond for his help in suggesting this test.
13. A formal specification of a model under uncertainty with flexible functional forms is a mind-boggling task! Roumasset (1976) believes that 'the risk neutral model provides a good first approximation for explaining peasant farmers' decision making' (p. 177).
14. This literature is surveyed by Bardhan (1980).
15. The data are published in Ministry of Agriculture and Irrigation (1974) for farms grouped by size. They were not available on an individual farm basis.
16. For further details, see Table 7.4, p. 201. in Ministry of Agriculture and Irrigation (1974).
17. For further details see Table 7.5, p. 202, *ibid*.
18. For details see Ministry of Agriculture (undated) Table III-16, p. 12 (FMS combined Report).
19. See Ministry of Agriculture and Irrigation (1974) Table 3.27, p. 46 and Appendix Tables 3.4A, 3.4B, 3.5 which give a monthly distribution of work.

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## 4.4

# The Response of Peasant Farmers to Price Incentives: The Use and Misuse of Profit Functions

P. N. Junankar

*The article is set in the context of evaluating the debate between the free-marketeers [Schultz et al.] and the institutionalists [Myrdal et al.]. It surveys the literature on the application of profit functions to agricultural production in LDCs. In particular it provides a critical review of the literature which focuses on the inadequacy of economic theory, the problems of econometric specification, data limitations, and the contradictory nature of the econometric results. Overall, it is argued that the profit function is inappropriate on theoretical grounds and that most of the economic applications do not support the model. The article concludes with suggestions for future work which should take account of the role of class, power, and interlinkages in an historical context. Social and institutional factors, it is argued, are important in determining the behaviour of peasant farmers.*

### I Introduction

Recent famines in Chad, Ethiopia and the Sudan have highlighted a major problem facing less developed countries: how does an LDC become self-sufficient in food production? The answers to this question range from the narrowly defined 'economic' one (or 'economistic' approach) to the more widely based institutional reforms approach. The former approach, typified by, say, Schultz [1964] or the World Bank [1982] would emphasise the importance of (mainly) price incentives. The latter approach as typified by Myrdal [1968] in his monumental work, *Asian Drama*, would emphasise the importance of land reforms as a *pre-condition* for agricultural development. The debate has sometimes followed a misleading path and discussed whether peasants are 'rational' or whether they are 'lazy', 'inert', 'tradition bound', etc. The aim of this article is to show that the use of profit functions

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to model peasant behaviour in LDCs is seriously flawed. Neo-classical economic theory (within which profit functions are embodied) ignores the historical, social, institutional and political context within which peasant farmers operate. Peasant farmers *do not* operate in full-blooded capitalist, impersonal, competitive input and output markets. The article is structured as follows: section II outlines the profit function approach and section III provides a survey and critique of applications of the profit function to LDC agriculture; section IV concludes with some general remarks on analysing peasant behaviour in an alternative paradigm.

## Section II

### The Profit Function Approach<sup>1</sup>

Since Lau and Yotopoulos' [1971] seminal paper on the application of profit functions to analysing agricultural production in LDCs numerous papers have been published. These papers all stress the superiority of this approach over the production function approach especially in terms of overcoming estimation bias and providing a convenient analytic device for comparing technical, price and economic efficiency of farmers.

The profit function approach is based on individual agents (farmers) maximising profits facing competitive (price-taking) input and output markets under certainty. Production possibility sets are assumed to be closed, convex, non-empty, monotonic and bounded. Let me begin by summarising this approach which uses duality theory.

Take a production function

$$Y=Y(X,Z) \quad (1)$$

where Y is output in physical units (for example, tons of wheat), X is a vector of (endogenous) variable inputs and Z is a vector of (exogenous or pre-determined) fixed inputs. This production function is assumed to be 'well behaved'.

Agents (farmers) are assumed to maximise profits ( $\pi$ ) defined as revenues less (variable) costs. Solving, we can write

$$\pi^* = \pi^*(C,Z) \quad , \quad \pi_c^* < 0 \quad ; \quad \pi_z^* > 0 \quad (2)$$

and

$$\frac{\partial \pi^*}{\partial C} = X^* = X^*(C,Z) \quad , \quad X_c^* < 0 \quad ; \quad X_z^* > 0 \quad ; \quad (\text{for all } i) \quad (3)$$

and

$$Y^* = Y^*(C,Z) \quad , \quad Y_c^* < 0 \quad ; \quad Y_z^* > 0 \quad (4)$$

( $\pi^*$  are the maximised real profits,  $X^*$  are the optimal variable inputs,  $Y^*$  is the optimal output and  $C$  are input prices normalised by the output price).

For estimation purposes only  $(n-1)$  equations are independent so usually only the profit function (equation 2) and the input demand functions (equation set 3) are estimated. The output supply equation (4) is deleted.

To this fairly conventional neo-classical economic theory, Lau and Yotopoulos [1971] and Yotopoulos and Lau [1973] (henceforth L-Y and Y-L respectively and L-Y-L for both papers) make two amendments:

(a) Allow for two (or a few) groups of farmers with different levels of 'technical efficiency'<sup>2</sup>

$$Y_1 = A_1 Y_1(X, Z) \quad (1a)$$

and 
$$Y_2 = A_2 Y_2(X, Z)$$

where the subscript refers to groups of farmers (e.g. small and large, or owner and tenant).  $A_i$  is an index of (multiplicative) efficiency: if  $A_1 > A_2$  then group 1 farmers are more technically efficient than group 2.

(b) Allow for two groups of farmers to *consistently* under or over estimate (some or all) input prices so that they equate

$$MP_i = \frac{\partial Y}{\partial X_i} = k_i C_i \quad k_i > 0 \quad (5)$$

where  $MP_i$  is the marginal product of the  $i$ th input. If  $k_i=1$  for all  $i$ , then farmers are price efficient, if  $k_i < 1$  the prices are underestimated and if  $k_i > 1$  they are overestimated. In some ways this is an attempt to capture the idea that prices faced by farmers may differ for different agents because markets are not perfect.<sup>3</sup>

Using this approach it is possible to test for differences in technical and/or price efficiency of different groups of farmers, see L-Y, Y-L, Sidhu [1974], Junankar [1980a, 1980b] *et al.*

For certain functional forms we can begin with a production function and derive a profit function. For a Cobb-Douglas production function we obtain a Cobb-Douglas profit function: they are self duals. However, if we take a translog production function we cannot derive an estimable profit function. An alternative approach is to begin with a translog profit function (which satisfies certain conditions on the production set) and then derive the input demand functions. (A translog profit function provides a second order approximation to any twice differentiable function: for example, Cobb-Douglas is a special case.) Economic theory imposes several restrictions on the set of equations 2 and 3. These restrictions are both *within* an equation and *across* equations. These restrictions are of homogeneity in all prices, consistency of the input demand equations with the profit function,

sign restrictions, symmetry (cross-partials are equal) and constant returns to scale.<sup>4</sup> It is especially worth noting that if we had increasing returns to scale the model would break down because no profit maximum exists and hence the profit *function* does not exist.

The advantages of the profit function approach over the normal production function approach, according to L-Y-L, are (i) that this allows for a testing of differences in technical efficiency, price efficiency, and economic efficiency between different groups of farmers, and (ii) in estimating production functions ordinary least squares estimates are biased and inconsistent (since the variable inputs are choice variables, and hence endogenous) while profit functions have price as independent variables which are (assumed to be) exogenous.

### Section III

#### A Survey and Critique of the Profit Function Approach

In this section I shall deal with several problems with the literature in this area under the following headings: (a) Theory, (b) Econometric Specification, (c) Data, and (d) Some Econometric Results.

(a) *Theory*: The first major theoretical problem with this approach is the assumption of *competitive* input and output markets. In the context of *developing* countries the assumption of the existence of capitalist competitive market flies in the face of facts.<sup>5</sup> The idea that capitalist markets for all inputs and output markets have developed fully so that farmers only respond to (anonymous) *price* signals by quantity adjustments has been disputed by Bhaduri [1973], Bharadwaj [1974], and Bardhan [1980]. In particular, the existence of 'free' that is, without restrictions on mobility, geographical or across employers) wage labour is a necessary condition for capitalist production. In fact there is some evidence for the existence of 'bonded' labour through either the credit or land market. Even if *capitalist* markets existed in developing countries, the existence of *competitive* markets is doubtful. Given the existence of imperfect information, inadequate access to transport and communications, local conditions provide varying degrees of monopoly power to landlords. In developing countries like India, class and power play an important role in transactions: prices may be person specific rather than competitive prices that are uniform for all agents.<sup>6</sup> In other words, not all agents are price-takers.

Let us for the sake of argument accept the assumption of competitive input and output markets and only concern ourselves (in a Friedmanite way) with the predictions of the model. If all farmers faced the same production function and faced the same vector of prices (in competitive markets) then all farmers would be producing with the *same* input combination and producing the *same* output. *It would be impossible to estimate a profit function.*

To estimate a profit function the farmers must face different vectors of prices: but if they face different prices they cannot be operating in competitive markets. There is a logical contradiction in this approach. The only possible solution to this is to assume that the different observations come from geographically distinct locations (so that markets are competitive within a location but transport or other costs prevent competition *across* locations). However, if the price variability is due to geographically distinct locations then it is unlikely that the farmers would face the *same* production function: there are soil, climatic, and other natural differences across different regions.<sup>7</sup> In other words, on a theoretical basis we cannot estimate profit functions using cross-section data: we either have competitive markets and profit function that cannot be estimated (because we only have a point in  $n$ -dimensional space), or we do not have competitive markets and profit functions do not exist.

Another problem worth noting is that different farms may be producing different crops or different *combinations* of crops. Analysing the farms by looking at one crop at a time may be misleading because of the externalities in production (via crop rotation): thus crop B followed by crop A may be more efficient than vice versa. Again, if there are externalities in cultivating two (or more) crops simultaneously a crop by crop analysis would be misleading. Analysis on a farm level basis would involve aggregation problems which may also lead to estimation problems, see Just, Zilberman Hochman [1983]. To take proper account of these problems we need to specify a dynamic sequential analysis, see Antle [1983a].

Another major problem with this approach is that the model is first presented under certainty conditions but when it is to be estimated an *ad hoc* random term is attached to the set of estimating equations. In fact, agricultural production is subject to a significant amount of uncertainty, as are input and output prices.<sup>8</sup> Once we allow for an uncertain world, do farmers maximise expected profits, expected utility or do they follow some safety first principle, or some satisficing rule? In fact if we specify the production function as a stochastic function then the duality results which enables us to obtain a profit function break down. In other words, once we allow for uncertainty the theoretical justification (even within the neoclassical paradigm) for the profit function approach breaks down.

(b) *Econometric specification*: Following L-Y most authors have specified a profit function with some variable and some fixed inputs. The original L-Y-L papers had one variable input (labour) and two fixed inputs (land and capital). Following L-Y-L, Sidhu [1974], Junankar [1980a] used the same classification of inputs. In particular, note that family and hired labour (as well as male/female, child/adult labour) were aggregated. Implicitly, this implies that the labour market is perfect so that the opportunity cost of family labour is the market wage rate. Of course, there is not *one* wage rate



but a whole vector of wage rates for different activities, and for different points of time in the agricultural season so that this is a gross simplification. Subsequent studies, Yotopoulos, Lau and Lin [1976], Sidhu and Baanante [1979] Junankar [1980*b*, 1982], Sidhu and Baanante [1981], extended the number of variable and fixed inputs although only Junankar [1980*b*, 1982] and Saleem [1984] distinguished between family and hired labour. Although there is no theoretical way of deciding how many inputs should be included in a production function, there are clearly problems in the definition of 'fixed' and 'variable' inputs. However, in the case of developing countries the distinction between family and hired labour is important and they should be entered separately in a production function. Again in Indian agriculture bullock labour is critical and the production (profit) function must allow for this input.

A second problem is econometric specification arises in choosing an appropriate functional form. Following L-Y-L many of the earlier papers specified a Cobb-Douglas production function which leads to a Cobb-Douglas profit function. As has been noted in the literature a Cobb-Douglas production function (with a unit elasticity of substitution) is a very restrictive production function. In a recent paper, Chand and Kaul [1986] draw out some of the implicit restrictions on the profit function namely (i) the own-price input demand elasticity is greater than one (in absolute terms), (ii) all variable inputs are complementary, (iii) symmetry of cross price elasticities, (iv) the effect of an increase in a fixed input is symmetric on all variable inputs (that is, like a scale effect) and (v) price elasticity of input demand with respect to output price is greater than one. Given the restrictive nature of a Cobb-Douglas production function, it seems appropriate to test the maintained hypothesis with a more general functional form. However, as mentioned earlier, if we take a translog production function we cannot derive a translog profit function; they are not self-duals. Instead we postulate a translog profit function and derive the implied input demand functions. It is assumed that the parameters of the translog profit function are such as to satisfy certain conditions on the production set. Sidhu and Baanante [1981], Junankar [1982] and Saleem [1984] estimate translog profit functions and test this general specification against a Cobb-Douglas functional form. Their results reject the Cobb-Douglas specification. This is clearly a better procedure than simply assuming a Cobb-Douglas specification.

A third problem arises in the specification of the input demand functions, equation 3.<sup>10</sup> Following L-Y-L (for the Cobb-Douglas case) several authors specified the input demand equations as input share costs in total profits. As such equation 3 becomes:

$$\frac{-C_i X_i}{\pi} = \beta_i \quad (3a)$$

where  $\beta_i$  is the exponent on input  $X_i$  in the C-D production function. Specified in this form  $\beta_i$  (the mean of the left hand side variable) *is bound to be negative* (since  $C_i$ ,  $X_i$  and  $\pi$  are all positive). An alternative is to estimate equation 3 as it stands or the following equation:

$$C_i X_i = f(C, Z) \quad (3b)$$

where in the Cobb-Douglas case the parameters in  $C$  and  $Z$  are *exactly the same* as of the profit function, equation 2. In my view this provides a more stringent test of the theory as we can see which variable input price is significant and more importantly test the restriction of equality of parameters across equations 2 and 3b. (This point is discussed further under item (d) below.)

A fourth problem arises in the addition of error terms to equations 2 and 3 (or 3a, or 3b) in an ad hoc manner. As mentioned earlier there are problems with stochastic duality. But it is worth noting that as Just and Pope [1978, 1979] have shown that a log additive error term in a production function implies that the marginal effect of increasing input use *increases* the variability of output. By analogy, for a C-D profit function an increase in the fixed inputs would *increase* the variability of profits: which is counter-intuitive. Just and Pope then suggest an alternative error specification for production functions which is perhaps the procedure that should be followed for profit functions as well. It is worth noting that following L-Y-L all authors estimate the equations allowing for co-variance of errors across equations by using Zellner's SURE method.

A final problem with the studies following in the L-Y-L footsteps is that the production (profit) functions are not treated as *frontier* functions.<sup>11</sup> Ignoring the problems of stochastic duality, we should estimate stochastic profit functions where technical and price (allocative) efficiency may not be independent.

(c) *Problems of data:* In cross-sectional studies of profit/production functions we need fairly detailed data on quantities of outputs, inputs, and prices of inputs and outputs. The L-Y-L studies used aggregative data (with a very small sample) while subsequent studies used farm-level data. Let me outline some of the data problems:

First, when the data are on a farm-level basis there are some farms which do not use some inputs: there are genuinely zero values for some inputs. This is not a problem of missing observations (data) because of non-collection of information. For example, some farms do not use *any* fertilisers, or hired labour, etc. For those farms a Cobb-Douglas (or any log-linear) function is clearly a mis-specification. In my view there is no 'correct' solution to this problem: the one I prefer is to simply delete that farm from the sample. This clearly leads to some unknown bias in the estimates for the remaining sample.

The second problem is in the measurement of variables.<sup>12</sup> There are serious problems in measuring fixed inputs like land (how does one allow for quality differences) and capital (does one use a 'user cost' measure with a uniform interest rate for all farmers?), measuring input prices (especially labour), and in denning profits (do we subtract *all* variable input costs even if we do not have a separate price index for some of them? do we allow for by-products?) One of the main difficulties lies in the aggregation of the variables over time (say a crop season), since in agriculture it is not only the quantity of the input that is important but also the *timing* and *sequence* of inputs applied.

(d) *Some econometric results:* In this sub-section I shall survey some of the work in this area. The key papers by L-Y-L which stimulated much of this work are based on estimating a Cobb-Douglas model by Zellner's Seemingly Unrelated Regression Estimation (SURE) method. Essentially the equations are of the form:

$$\ln \pi = \beta_0 + \sum_1^n \beta_i \ln C_i + \sum_1^m \gamma_i Z_i + u_1 \quad (2a)$$

$$\frac{-C_i X_i}{\pi} = b_i + u_{i+1} \quad i = 1, \dots, n \quad (3a')$$

These equations should be estimated with  $\pi$  and  $C_i$  being normalised by the output price, although some of the earlier papers by L-Y-L, Sidhu [1974], Khan and Maki [1979] do not do so due to an alleged lack of data on output price. These equations are estimated in an unrestricted form and then subject to restrictions that  $\beta_i = b_i$  (all  $i$ ) and  $\sum \gamma_i = 1$  (constant returns to scale). Note, however, that  $b_i$  by *definition* must be negative and is in fact an estimate of the mean of the L.H.S. Table 4.4.1 attempts to summarise some of the profit functions that have been fitted for the Cobb-Douglas case. The original L-Y paper only estimated the profit function using *grouped* data from several Indian States based on the mid-1950s Farm Management Studies data. The results, although interesting, should be treated with some suspicion since one of the fixed inputs ('capital') comes out with a *negative* and statistically significant coefficient. The subsequent Y-L paper estimates two equations but again come out with a negative sign on capital which they ascribe to mis-specification of the variable. It is also worth noting that in the unrestricted equation *only* land is a significant variable (ignoring dummies and constant terms). These results are also likely to be affected by hetero-scedasticity as the data are based on grouped averages. In addition, the price variables are not normalised by the output price but regional dummies are introduced to proxy for them. However, as discussed earlier it is not clear why input and output prices should differ in a competitive market except for geographical differences. These regional dummies would, therefore, also normalise the wage rates across states. Overall, these results do not provide much support to the profit function model.

Table 4.4.1 Comparison of Cobb-Douglas Profit Functions

| Author                            | Method                                                     | No. of<br>Variable Inputs | No. of Fixed<br>Inputs | Percentage<br>of sign violations | Percentage of<br>significant coefficients | Returns<br>to Scale |
|-----------------------------------|------------------------------------------------------------|---------------------------|------------------------|----------------------------------|-------------------------------------------|---------------------|
| 1. L-Y                            | OLS<br>1 equation                                          | 1                         | 2                      | 33.3*                            | 66.7*                                     | IRS                 |
| 2. Y-L                            | SURE<br>2 equations (Unrestricted)                         | 1                         | 2                      | 33.3*                            | 33.3*                                     | IRS                 |
| 3. Y-L                            | SURE<br>2 equations (Restricted)                           | 1                         | 2                      | 33.3                             | 100.0                                     | CRS                 |
| 4. Sidhu (1974)                   | SURE 2<br>equations (Unrestricted)<br>(1967-68 to 1970-71) | 1                         | 2                      | 0                                | 66.7                                      | IRS                 |
| 5. Sidhu (1974)                   | SURE<br>2 equations (Restricted)<br>(1967-68 to 1970-71)   | 1                         | 2                      | 0                                | 100                                       | IRS(†)              |
| 6. Yotopoulos<br>Lau & Lin (1976) | SURE<br>5 equations (Unrestricted)                         | 4                         | 2                      | 33.3                             | 66.7                                      | IRS                 |
| 7. Yotopoulos<br>Lau & Lin (1976) | SURE<br>5 equations (Restricted)                           | 4                         | 2                      | 0                                | 100                                       | CRS                 |
| 8. Sidhu Baanante (1979)          | SURE<br>4 equations (Unrestricted)                         | 3                         | 3                      | 0                                | 33.3                                      | IRS                 |
| 9. Sidhu Baanante (1979)          | SURE<br>4 equations (Restricted)                           | 3                         | 3                      | 0                                | 83.3                                      | CRS                 |
| 10. Khan & Maki                   | SURE<br>2 equations (Unrestricted)                         | 1                         | 2                      | 0                                | 66.7                                      | IRS                 |
| 11. Khan & Maki                   | SURE<br>2 equations (Restricted)                           | 1                         | 2                      | 0                                | 100                                       | IRS(†)              |
| 12. Junankar (1980b)              | SURE<br>4 equations (Unrestricted)<br>(Kuruvai)            | 3                         | 2                      | 40.0                             | 20.0                                      | IRS                 |
| 13. Junankar (1980b)              | SURE<br>4 equations (Restricted)<br>(Kuruvai)              | 3                         | 2                      | 20.0                             | 40.0                                      | DRS                 |

Notes: CRS = Constant Returns to Scale; IRS = Increasing Returns to Scale; DRS = Diminishing Returns to Scale.

† Statistically significant.

In a subsequent paper Yotopoulos, Lau and Lin [1976] (henceforth Y-L-L) used farm level data from Taiwan to estimate a Cobb-Douglas model. Again in the unrestricted model only *some* of the signed input prices are statistically significant! Even some of the correctly signed variables are not significant. It is only after imposing restrictions  $\beta_i = b_i$  that the model performs better (see below). Y-L-L then go on to pool data for 1967 and 1968 after carrying out tests of structural stability. In these pooled results (subject to various restrictions) they still have two input prices and capital which are not statistically significant (the standard error on land is unfortunately missing from the table). Thus these results leave much to be desired.

Sidhu [1974] followed the L-Y-L procedure using farm-level data (hence overcoming one of the problems with the L-Y-L papers). However, for some unknown reason he does not normalise profits and input prices by the output prices. It is interesting that when he estimates an unrestricted model he obtains a *positive* coefficient on wage rates. When the model is estimated subject to restrictions the sign flips but an F-test rejects the restrictions! However, these results are absolutely meaningless since he finds *increasing returns to scale*! As mentioned earlier, when production is subject to increasing returns to scale no maximum exists and hence a profit function is meaningless. Sidhu and Baanante [1979] estimate an extended version of this model with more variable and fixed inputs. In an unrestricted form *none* of the input prices (normalised by output price) is significant and only land and capital came out significantly. It is only on imposing the restrictions that  $\beta_i = b_i$  input prices turn out significant. These results although stronger than the earlier results are still subject to the strictures made earlier. In particular, the estimation of equations 3 which only provide an estimate of the mean of the LHS variable is used to constrain the  $\beta_i$  which are very poorly determined and hence the restrictions are not rejected. A more appropriate method would be to estimate equations 2 and 3b as done in Junankar [1980b]. Khan and Maki [1979] in their study also find increasing returns to scale: in other words their results are meaningless.

Junankar [1980a, 1980b] uses farm level data for two Indian States (Punjab and Tamil Nadu) and finds that the model performs poorly. In the former paper, the real wage variable always has an incorrect sign except where it is restricted ( $\beta_i = b_i$ ) but an F-test rejects the restriction. In the latter paper which has more variable inputs (family labour, hired labour, bullock labour) only bullock labour is correctly signed and significant. In the restricted estimation ( $\beta_i = b_i$ ) the restrictions are rejected. A more direct test is proposed, namely estimating equations 2 and 3b. In this case only about 50 per cent of the real input prices are correctly signed. Again the restrictions  $\beta_i = b_i$  are rejected throwing doubt on the profit function model.

Karlirajan [1981] estimated a Cobb-Douglas model with four variable inputs and two fixed inputs using data from Tamil Nadu. The approach

followed was similar to L-Y-L except that the model was estimated by Aitken's Generalised Least Squares method using a Lagrangian multiplier. Unfortunately, unrestricted estimates are not presented to make it comparable to earlier studies. As in other studies the equations are estimated with restrictions  $\beta_i = b_i$  (equations 2a and 3a'). Similar strictures apply to this study as to the earlier ones.

In some recent papers, Sidhu and Baanante [1981] and Junankar [1982] estimated a translog profit function jointly with the input demand functions. Sidhu and Baanante [1981] estimate a model with three variable inputs (labour, oxen labour, fertilisers) and seven fixed inputs (capital, land, various soil qualities, education and number of irrigations). It is difficult to understand why the amount of nitrogen and potassium in the soil is treated as a *fixed* input. The model is estimated subject to symmetry assumptions after some interaction terms are suppressed without a statistical test being carried out (see fn. 3 on p.239). The results presented in their Table 1 have only nine out of 30 parameters which are significant in the input demand functions and only 3 out of 54 are significant in the profit function. These are hardly results to write home about!

Junankar [1982] estimated a translog model with three variable inputs (family labour, hired labour, bullock labour) and two fixed inputs (land and capital). The model was estimated subject to all the restrictions on homogeneity in prices, symmetry, equality across equations, and constant returns to scale. All these restrictions were rejected using a log-likelihood ratio test.<sup>13</sup> Thus this more general functional form rejects the profit function approach.

In this section we have argued that the profit function approach is inadequate on theoretical and econometric grounds. The review suggested that most of the earlier studies provide little or no support for neo-classical economic theory as encapsulated in the profit function approach.<sup>14</sup>

## Section IV

### Conclusions

In analysing the behaviour of farmers in a less developed economy we need to specify the socio-economic and historical context. Unless the conditions for a competitive capitalist economy have developed it seems inappropriate to use models which assume that farmers respond only to *price* signals. The first step must be one which simply *describes* the socioeconomic relationships between different classes or groups in rural society. The matrix within which a rich powerful capitalist farmer operates is very different from that in which a small peasant farmer operates. The rich farmer has access to *more* markets via better transport and communications. Because of access to (cheap) credit he has the ability to engage in activities which may have a longer-run pay-off as well as to iron out any seasonal fluctuations in prices of inputs or outputs. Thus not only is the production technology different but so are the vector of prices faced by him.

A second important step must be the identification and measurement of interlinkages between contracts in different markets. These interlinkages vitiate standard neoclassical theory. These interlinkages may be based on history, custom, caste or class. The economic rationale for these interlinkages may be to provide incentives in the absence of imperfect information and monitoring, see Stiglitz [1985] and Eswaran and Kotwal [1985].

A third step is an analysis of *the dynamics of change* in a rural environment. What forces lead to *changes* in land ownership, tenancy arrangements, labour market contractual arrangements and finally changes in production technology.

An analysis of the rural economy must also look for linkages with the industrial sector (or the rest of the world). The remittances from migrants to Western or Arab countries may lead to a change in power relationships within the rural sector, for instance.

Thus a new paradigm must encompass the concepts of class, power, interlinkages, and the role of institutional and social factors. All these must be considered in a historical context.

In this paper we have surveyed the literature on profit functions and argued that the approach is inadequate theoretically and econometrically. It was argued that the implications are not that farmers are lazy or irrational but that the model is inappropriate. Farmers do respond to economic incentives given the limited freedom available to them. It was suggested that we need to explore an alternative paradigm which allows for concepts of class, power, interlinkages, and the role of social and institutional factors.

## Notes

Paper presented to the Eighth International Economic Association World Congress (New Delhi, India, 1–5 December 1986). I am grateful to participants for their comments but they are not responsible for remaining errors. The article has also benefited from comments from an anonymous referee.

1. For a detailed discussion see Diewert [1974].
2. Note that this technical efficiency is different from the idea of the 'frontier production function', see below.
3. Professor Yotopoulos stresses this point in a letter to me.
4. For details see L-Y-L, and Junankar [1982].
5. See Junankar [1982] for some evidence to support this statement.
6. Yotopoulos et al allow for difference in prices faced by a few groups.
7. This point is also discussed in a paper by Quiggin and Bui-Lau [1984] which I saw after I had presented an earlier version of this paper at the Australian National University.
8. As with uncertainty the *sequential* decision making becomes very important. See Antle [1983a].
9. See Lipton [1968], Roumasset [1976], Just and Pope [1978, 1979], Antle [1983b], Pope [1982].
10. See Junankar [1980b].
11. For an excellent review see Forsund *et al.* [1980].
12. See Junankar [1980a, 1980b].

13. Note that the F-test is inappropriate in such circumstances.
14. This is not the place to review or discuss the burgeoning literature on supply response functions, supply and demand models, linear or dynamic programming models. Certainly linear and dynamic programming models are better normative tools for maximising behaviour under risk, see Schluter and Mount [1976, Pope [1982], Antle [1983a, 1983b]. Recent work on supply and demand models for agriculture has used 'switching regression' methods see Bevan *et al.* [1987].

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# 5

## Informal Labour Markets

# 5.1

## The Informal Labour Market in India: Transitory or Permanent Employment for Migrants?

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*This paper studies the characteristics of the workers in the informal economy and whether internal migrants treat this sector as a temporary location before moving on to the organised or formal sector to improve their lifetime income and living conditions. We limit our study to the Indian urban (non-agricultural) sector and study the characteristics of the household heads that belong to the informal sector (self-employed and informal wage workers) and the formal sector. We find that household heads that are less educated, come from poorer households, and/or are in lower social groups (castes and religions) are more likely to be in the informal sector. In addition, our results show strong evidence that the longer a rural migrant household head has been working in the urban areas, ceteris paribus, the more likely that individual has moved out of the informal wage sector. These results support the hypothesis that, for internal migrants, the informal wage labour market is a stepping stone to a secured life in the formal sector.*

### 1 Introduction

In most developing countries, there is a large sector of the economy that is called the informal sector or the unorganized sector. Employment in the informal labour market plays an important role in most developing economies. Very broadly, the informal labour market consists of workers in the informal sector, plus casual workers in the formal sector. The informal labour market is a very large part of the agricultural sector, but is also a significant part of the urban sector. There is a difference between employment in the formal sector and the informal sector in terms of the conditions of work, whether workers are subject to government taxes, have access to social

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security or insurance, are casual or contract workers, and whether or not they receive the minimum wages<sup>1</sup>.

The informal economy is a very important sector of the Indian economy. The National Council of Applied Economic Research estimates that the informal sector—'unorganized sector'—generates about 62% of GDP, 50% of national savings and 40% of national exports (ILO 2002, p. 30). In terms of employment, the informal economy provides for about 55% of total employment (International Labour Organisation 2002, p. 14)<sup>2</sup>. Urban areas (especially large cities) attract numerous migrants from both the rural areas and from smaller urban towns and cities in the hope of a better life.

The Indian labour market can be conceived of as a segmented market. One segment is the formal sector composed of workers who have salaried work, good working conditions, and are employed in organised business. The other segment is the informal economy consisting of small self-employed traders and business people, and casual workers in the informal or formal sectors. Some individuals are born into wealthy families who own large businesses and hence are in the formal sector by right of birth. Others who are born with parents from the professional classes would almost certainly have education from good schools and universities, and have a network of contacts that would ensure their joining the ranks of the employed in the formal sector. Some individuals may have built up sufficient assets over time to set up small businesses and hence enter the formal sector. However, most workers in the formal sector enter the sector through their educational achievements, or by birth (children of rich people) and through social networks. For someone who comes from a disadvantageous background (either in terms of income or belonging to a socially backward caste or religion) the only way to enter the formal sector is via education in 'good' schools<sup>3</sup> or universities. Even with a good education, entry into the formal sector is often based on family connections. The Indian government has for some time had a policy of positive discrimination for the Dalits, and as a result they may have a higher probability of finding a job in the formal (government) sector. Migrants (especially from rural areas) who come into urban areas would likely have to work in the informal sector for some time before they build good networks enabling them to move into the formal sector.

The literature on the role of the informal sector in developing countries has oscillated between treating the informal sector as a backward sector that is holding back economic development to a dynamic sector that is helping to develop the economy rapidly without straining foreign currency balances and with relatively low demands for (real) capital goods (see Mazumdar 1976, Weeks 1975, Bromley 1978, Gerxhani 2004)<sup>4</sup>. The informal sector is considered to be a pre-capitalist form of production compared to the formal sector which is a profit maximising capitalist sector. There is a large volume of literature on rural-urban migration (see Harris and Todaro 1970) that examines migrants arriving in the city and initially finding work in the informal sector, then moving on to better paid work in the formal

sector. Fields (2009) developed an early model of the informal sector as a 'way station' along the path toward a formal job in urban areas (De Mel *et al.* 2010) which has been followed by others. This view of the informal sector as a temporary abode for migrants has been disputed (among others) by Mazumdar (1976). The debate has also ranged over whether informal sector workers are living in poor conditions with low incomes, or whether some of the informal sector workers are there out of choice and have a comfortable life (see Meng 2001, Perry 2007). Some individuals may have employment in the formal sector and work in the informal sector as well.

Given the setup of the urban labour market in India, some of the important issues to investigate are (1) whether individuals working in the informal sector are migrants and whether they move out of the informal sector into the formal sector after a few years; (2) whether they are from disadvantaged social and ethnic groups who do not have social networks to enter the formal sector; and finally (3) whether those with low levels of education and skills are unable to enter formal sector employment and have to find low paid works in the informal sector (Mitra 2004, 2008).

This paper is interested in studying the characteristics of the workers in the informal economy and whether migrants treat this sector as a permanent base or only as a temporary location before moving on to the organised or formal sector to improve their lifetime income and lifestyle. We limit our study to the Indian urban (non-agricultural) sector and study the characteristics of the household heads that belong to the informal sector (self-employed and informal wage workers) and the formal sector. We find that members who come from the lower social groups (castes and religions) are more likely to be in the informal sector. We distinguish between migrants in urban location who came from rural areas and those who came from other urban areas. We find that rural migrants' likelihood of staying in the informal wage labour sector is inversely related to the length of time a rural migrant spends in an urban area.

In Section 2 below, we clarify the definition of informal labour markets and briefly review the literature; Section 3 provides a detailed discussion of the properties of the urban informal sector in India; Section 4 discusses the lexicographic preferences that people have over formal sector, self-employment, and informal wage labour; Section 5 sets up an econometric model for estimating the probability of working in the informal sector and provides some results, while Section 6 provides results using a multivariate logit model; Section 7 concludes with a summary of the results. In general, we find that the longer the duration of a migrant in the urban sector the more likely s/he will have moved out of the informal sector.

## **2 The informal labour market: definitions and a review of some earlier studies**

In the developing country context, the informal sector is sometimes defined in terms of the activities of the enterprises (ILO 1972) and sometimes in terms

of the kind of work done by individuals as employees or as self-employed people (Hart 1973). There exists great heterogeneity in informality: there is the 'intra-firm margin where firms may be partly formal and partly informal, the inter-sectoral margin between formal and informal firms, and the inter-sectoral margin of formal and informal workers operating through the labour market' (Perry *et al.* 2007).

The International Labour Organisation (1972) characterised the informal sector as:

- (a) Ease of entry
- (b) Reliance on indigenous resources
- (c) Family ownership of enterprise
- (d) Small scale of operation, often defined in terms of hired workers less than (say) ten
- (e) Labour-intensive methods of production and adapted technology
- (f) Skills acquired outside the formal school system
- (g) Unregulated and competitive markets

Whereas the formal sector was characterised by:

- (a) Difficult entry
- (b) Frequent reliance on overseas resources
- (c) Corporate ownership
- (d) Large scale of operation
- (e) Capital-intensive and often imported technology
- (f) Formally acquired skills, often expatriate
- (g) Protected markets (through tariffs, quotas, and licenses)

Hart (1973) discussed the informal sector in terms of the working conditions of the individuals and whether they worked for wages with good conditions or informally as self-employed workers. Informal activities included:

- (a) Farming, market gardening, self employed artisans, shoemakers, tailors, etc.
- (b) Working in construction, housing, road building
- (c) Small scale distribution, e.g. petty traders, street hawkers, etc.
- (d) Other services, e.g. barbers, shoe-shiners etc.
- (e) Beggars
- (f) Illegal activities like drug pushing

Formal sector income earning activities included:

- (a) Public sector wage earners
- (b) Private sector wage earners (on permanent contracts, not casual workers)

Sengupta (2009, p. 3) defined the informal economy thus:

### **2.1 Informal sector**

The unorganised sector consists of all unincorporated private enterprises owned by individuals or households engaged in the sale and production of goods and services operated on a proprietary or partnership basis and with less than ten total workers.

### **2.2 Informal worker/employment**

Unorganised workers consist of those working in the unorganised sector or households, excluding regular workers with social security benefits provided by employers and the workers in the formal sector without any employment and social security benefits provided by employers.

### **2.3 Informal economy**

The informal sector and its workers plus the informal workers in the formal sector constitute the informal economy.

## **3 The Indian informal labour market: some background information**

A recent report of the National Commission for Enterprises in the Unorganised Sector by the Government of India (Sengupta 2009) found that 86% of the total employment in 2004–2005 was in the informal sector. Further, the agricultural sector consisted almost entirely of informal workers. The non-agricultural workers in the informal sector were 36.5% of the total, most of whom were self-employed. From 1999–2000 to 2004–2005 most of the increase in employment in the formal sector consisted of informal workers (Sengupta 2009, p. 14). The NSSO (2012, p ii) document found that in 2009–2010 in the non-agriculture sector, nearly 71% of the workers in rural areas and 67% in urban areas worked in the informal sector. It found that the informal sector activities are concentrated mainly in the manufacturing, construction, wholesale and retail trades, and transport, storage and communication industries.

Our study used data from the India Human Development Survey (IHDS) 2005, conducted by the Inter-university Consortium for Political and Social Research, Ann Arbor, Michigan, USA. The survey is a nationally representative, multi-topic survey of 41,554 households in 1,503 villages and 971 urban neighbourhoods across India. The data set has detailed information on household employment by industry and occupation, and detailed information about household characteristics including age, education, ethnicity, religion, and migration status. In this study we have limited our analysis to workers in the urban sector who are not engaged in any agricultural activities.

Our data-set consisted of 12,056 heads of households for whom we had data on their age, education, marital status, gender, religion, caste, income source, assets, migration status and years since migration into the urban sector.

We define the urban informal sector as artisans, petty traders, small business people (who do not hire any labour), and non-agricultural casual workers in the informal or formal sectors. The informal sector consists of the self-employed and informal wage labour. We define self-employment as petty traders who do not hire any workers and those in the organised trade/business category who do not hire any workers. Note that this is a stricter definition than that suggested by, for example, Sengupta (2009). The informal wage labour category covers those who are in the informal sector but are not self-employed, i.e., the artisans, and non-agricultural labourers who are casually employed. The formal sector consists of salaried employees, professionals, and organised trade/business people who hire workers. In our study we limited our analysis to only the heads of the representative households. The summary statistics of our sample is depicted in Table 5.1.1.

It is interesting to notice the industry and occupational distribution of the formal and informal sectors of the economy in our sample data (see Figure 5.1.1). Most of the informal wage labour is in manufacturing, construction, wholesale and retail trades, restaurants, and hotels, and in community, social and personal services. Self-employment is concentrated (not surprisingly) in the wholesale and retail trades, restaurants, and hotels. Informal wage labour is concentrated in occupations: production and related workers, transport equipment operators and labourers (presumably unskilled workers) (see Figure 5.1.2).

If we look at the distribution of migrants moving into these sectors, (see Figure 5.1.3) we find that 61% of the migrants work in the formal sector; almost 10% are self-employed entrepreneurs and 29% are informal wage workers.

A high proportion of migrants (28%) are working primarily in the community, personal and social services, 23% in wholesale and retail trades, restaurants and hotels, and 28% in manufacturing (see Figure 5.1.4).

A high proportion of migrants (30%) are employed as production and related workers, transport equipment operators and labourers while almost 29% are sales and service workers (see Figure 5.1.5). It is interesting to note that the main income source for migrants (50.14%) is salaried employment; another 21.09% are in non-agricultural labour (see Figures 5.1.6).

The caste and religion breakdown for the formal and informal sectors (self-employed and informal wage labour) show interesting patterns. As one would suspect, Brahmins and people belong to high caste are more likely to be in the formal sector, compared to the lower social castes and Muslims. If we divert our attention to the distribution of people by caste and religion based on the principal source of household income, as depicted in Table 5.1.2, we see that Brahmins and people belong to high caste are more likely to be salaried workers or professionals, whilst Dalits and Muslims are more likely to be non-agricultural labourers or artisans (see Figure 5.1.7).



Table 5.1.1 Summary statistics

|                                   | Formal                     | Informal                 | Total                     |
|-----------------------------------|----------------------------|--------------------------|---------------------------|
| Male                              | 0.902<br>(0.297)           | 0.935<br>(0.246)         | 0.916<br>(0.277)          |
| Rural to urban migration          | 0.283<br>(0.45)            | 0.246<br>(0.431)         | 0.267<br>(0.443)          |
| Rural to urban migration duration | 4.337<br>(9.077)           | 3.595<br>(8.355)         | 4.023<br>(8.787)          |
| Income (in Rupees)                | 103171.280<br>(124176.363) | 49812.840<br>(51689.736) | 80625.834<br>(103573.581) |
| Age                               | 45.968<br>(11.936)         | 43.181<br>(12.299)       | 44.791<br>(12.169)        |
| Size of the Household             | 4.842<br>(2.089)           | 5.066<br>(2.089)         | 4.937<br>(2.092)          |
| Married                           | 0.984<br>(0.124)           | 0.983<br>(0.128)         | 0.984<br>(0.126)          |
| Primary Education                 | 0.053<br>(0.223)           | 0.148<br>(0.355)         | 0.093<br>(0.290)          |
| Secondary Education               | 0.168<br>(0.374)           | 0.301<br>(0.459)         | 0.224<br>(0.417)          |
| Matriculation Complete            | 0.177<br>(0.382)           | 0.170<br>(0.376)         | 0.174<br>(0.379)          |
| Tertiary Education                | 0.163<br>(0.370)           | 0.099<br>(0.299)         | 0.136<br>(0.343)          |
| Graduate                          | 0.399<br>(0.490)           | 0.123<br>(0.328)         | 0.283<br>(0.450)          |
| Adivasi                           | 0.041<br>(0.197)           | 0.024<br>(0.152)         | 0.033<br>(0.180)          |
| Dalit                             | 0.143<br>(0.350)           | 0.178<br>(0.382)         | 0.158<br>(0.365)          |
| Muslim                            | 0.108<br>(0.310)           | 0.218<br>(0.413)         | 0.154<br>(0.361)          |
| Father's Occupation: Professional | 0.111<br>(0.314)           | 0.056<br>(0.230)         | 0.089<br>(0.285)          |
| Father's Occupation: Executive    | 0.030<br>(0.169)           | 0.010<br>(0.098)         | 0.022<br>(0.145)          |
| Father's Occupation: Clerk        | 0.108<br>(0.311)           | 0.036<br>(0.186)         | 0.079<br>(0.270)          |
| Father's Occupation: Sales        | 0.132<br>(0.338)           | 0.189<br>(0.392)         | 0.155<br>(0.362)          |
| Father's Occupation: Service      | 0.113<br>(0.316)           | 0.085<br>(0.279)         | 0.102<br>(0.302)          |
| Father's Occupation: Agro         | 0.352<br>(0.478)           | 0.341<br>(0.474)         | 0.347<br>(0.476)          |
| Father's Occupation: Labourer     | 0.155<br>(0.362)           | 0.284<br>(0.451)         | 0.207<br>(0.405)          |
| Father's Education: Primary       | 0.222<br>(0.416)           | 0.226<br>(0.418)         | 0.224<br>(0.417)          |

(continued)

Table 5.1.1 Continued

|                                | Formal           | Informal         | Total            |
|--------------------------------|------------------|------------------|------------------|
| Father's Education: Secondary  | 0.236<br>(0.425) | 0.140<br>(0.347) | 0.196<br>(0.397) |
| Father's Education: Tertiary   | 0.050<br>(0.218) | 0.014<br>(0.119) | 0.035<br>(0.184) |
| Father's Education: Graduation | 0.063<br>(0.243) | 0.013<br>(0.115) | 0.042<br>(0.201) |
| <i>N</i>                       | 6962             | 5094             | 12056            |

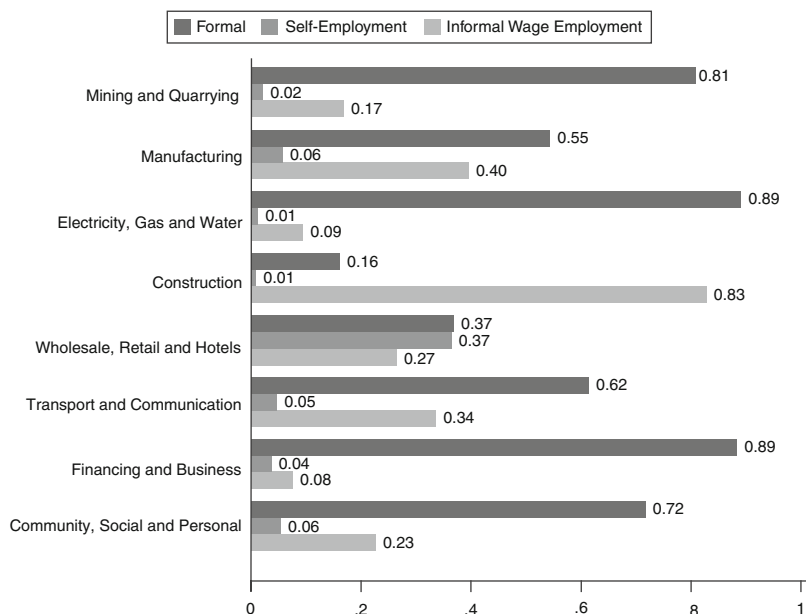


Figure 5.1.1 Distribution of employment across industries

When we look at the distribution of occupations by caste and religion, as depicted in Table 5.1.3, we note that Brahmins and high caste people are more likely to be in the higher level occupations, while Dalits and Muslims are more likely to be in the lower level occupations.

#### 4 The informal economy: some analytical features

We assume that individuals would, in general, prefer to work in the formal sector, either as employees or as owners/managers<sup>5</sup>. This is based on the idea

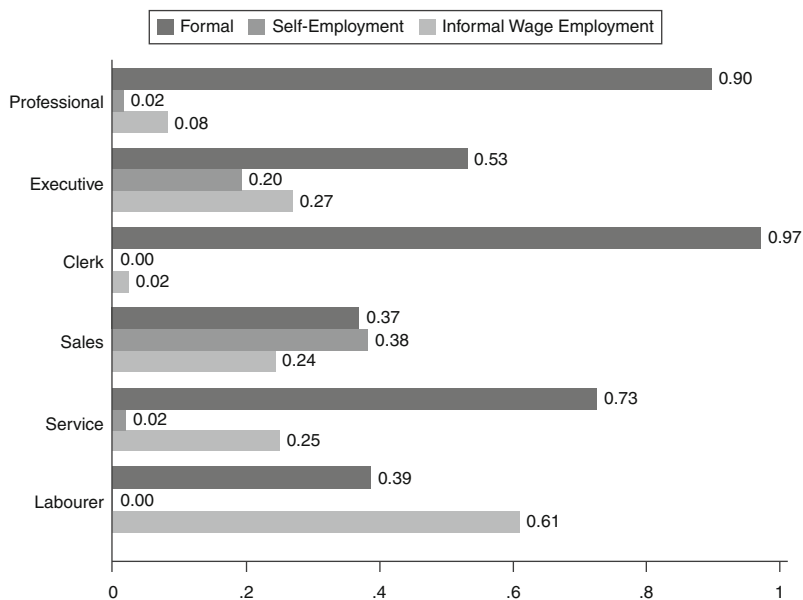


Figure 5.1.2 Distribution of households across occupations

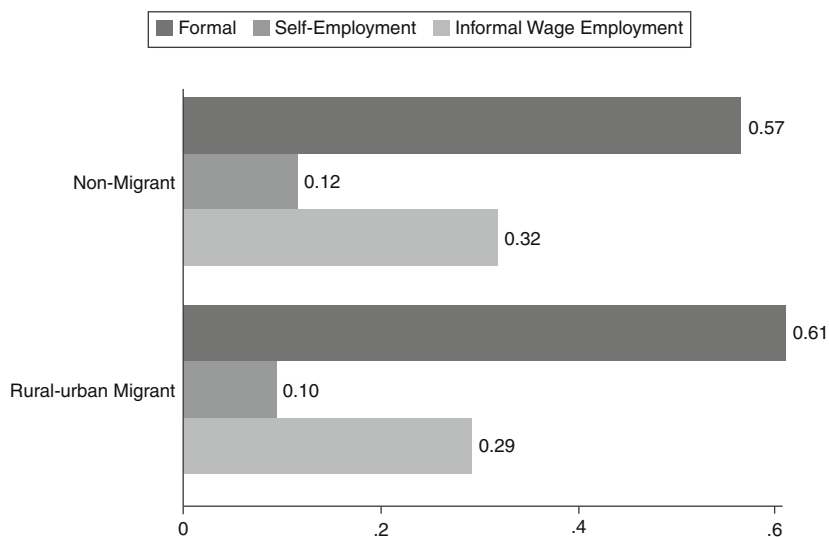


Figure 5.1.3 Employment category based on migration status

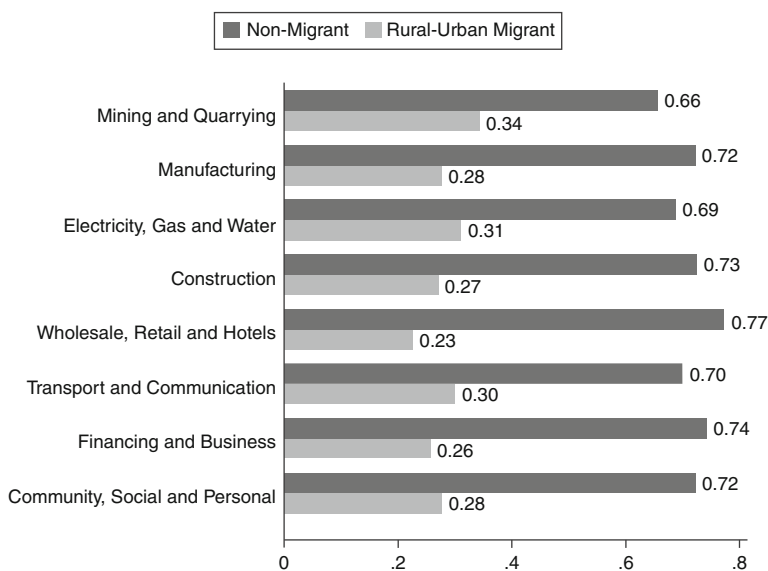


Figure 5.1.4 Migrants by industry

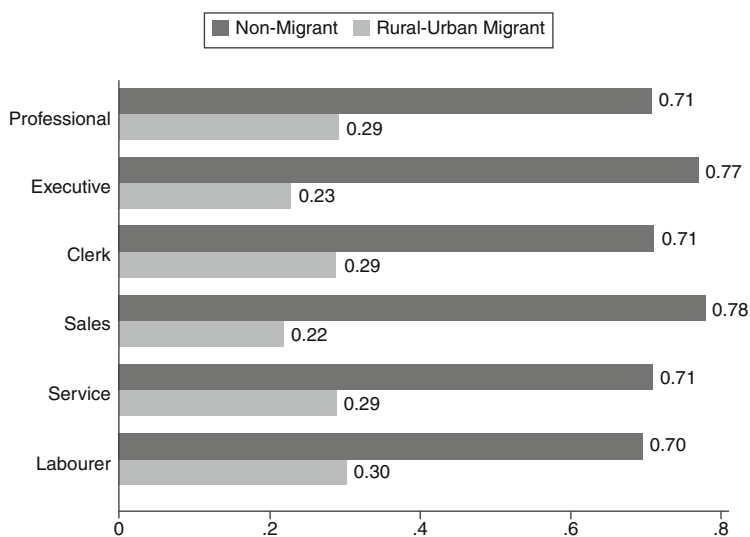


Figure 5.1.5 Migrants by occupation

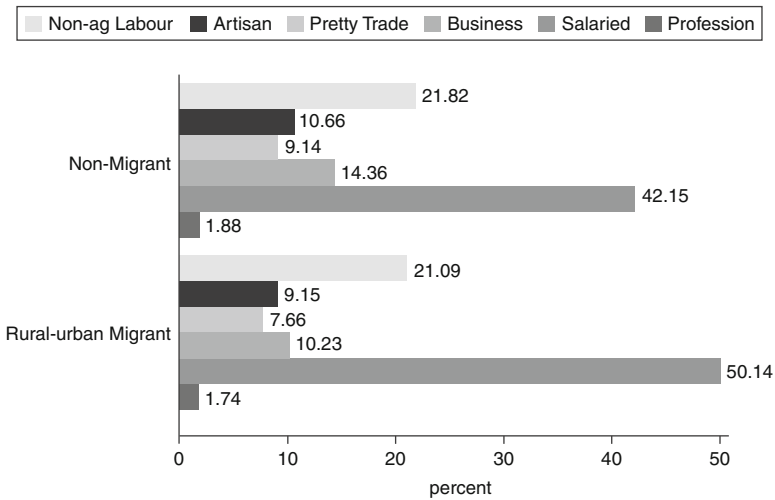


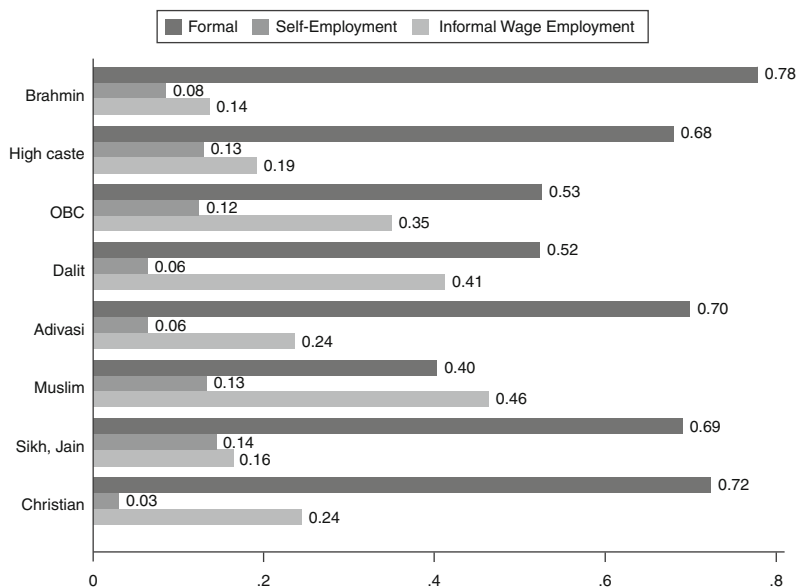
Figure 5.1.6 Migrants and income source

Table 5.1.2 Caste and religion by source of income

|              | Non-Ag labour | Artisan      | Petty traders | Business     | Salaried     | Professionals | Total         |
|--------------|---------------|--------------|---------------|--------------|--------------|---------------|---------------|
| Brahmin      | 56            | 67           | 68            | 136          | 705          | 43            | 1,075         |
| High caste   | 254           | 182          | 277           | 536          | 1,429        | 59            | 2,737         |
| OBC          | 875           | 437          | 341           | 446          | 1,438        | 56            | 3,593         |
| Dalit        | 664           | 205          | 105           | 108          | 803          | 18            | 1,903         |
| Adivasi      | 97            | 11           | 16            | 35           | 238          | 6             | 403           |
| Muslim       | 598           | 295          | 211           | 256          | 471          | 29            | 1,860         |
| Sikh, Jain   | 9             | 20           | 32            | 61           | 129          | 5             | 256           |
| Christian    | 54            | 19           | 4             | 20           | 126          | 6             | 229           |
| <b>Total</b> | <b>2,607</b>  | <b>1,236</b> | <b>1,054</b>  | <b>1,598</b> | <b>5,339</b> | <b>222</b>    | <b>12,056</b> |

Source: India Human Development Survey.

that the formal sector provides a better life not only in terms of present and future income, but also in terms of better working conditions (e.g., security of tenure, social security benefits, access to unions, safer working conditions). If they are unable to enter the formal sector, we assume that they would prefer to be self-employed (as long as their expected incomes are not below that in the informal wage sector). Employees in the informal wage sector would prefer to become self-employed if they have access to credit to set up small businesses. Many of them may simply be 'waiting' for a job in the formal sector. In the Harris-Todaro model, rural migrants come to the urban areas as long as their expected wages (urban wage multiplied by the probability of finding a job) are greater than their rural subsistence wage. Migrants

*Figure 5.1.7* Caste and religion by sector*Table 5.1.3* Caste and religion by occupation

|                                                  | Brahmin      | High caste   | OBC          | Dalit        | Adivasi    | Muslim       | Sikh, Jain | Christian  | Total         |
|--------------------------------------------------|--------------|--------------|--------------|--------------|------------|--------------|------------|------------|---------------|
| Professions, Technical and Related Workers       | 195          | 280          | 245          | 105          | 49         | 72           | 27         | 72         | 995           |
| Administrative, Executive and Managerial Workers | 135          | 357          | 427          | 147          | 28         | 243          | 35         | 27         | 1,399         |
| Clerical and Related Workers                     | 188          | 329          | 361          | 191          | 50         | 84           | 23         | 24         | 1,250         |
| Sale Workers                                     | 190          | 746          | 765          | 235          | 52         | 445          | 97         | 21         | 2,551         |
| Service Workers                                  | 71           | 172          | 210          | 248          | 44         | 87           | 11         | 18         | 861           |
| Production, Transport and Labourers              | 159          | 551          | 1,236        | 799          | 141        | 732          | 41         | 67         | 3,726         |
| Missing                                          | 137          | 302          | 349          | 178          | 39         | 197          | 22         | 50         | 1,274         |
| <b>Total</b>                                     | <b>1,075</b> | <b>2,737</b> | <b>3,593</b> | <b>1,903</b> | <b>403</b> | <b>1,860</b> | <b>256</b> | <b>229</b> | <b>12,056</b> |

Source: India Human Development Survey.

who do not find work in the urban formal sector then enter the urban informal sector which is meant to be a form of 'wait unemployment'<sup>6</sup>. Essentially, we are arguing that individuals have lexicographic preferences over these choices. However, what we observe is a reduced form depending on the household head's choice and success in the formal labour market,

and the constraints in the credit market that determine whether s/he can become self-employed. Informal wage labour then is a residual category.

In fact if we look at the actual income (based on our sample), we find that the incomes of these three groups overlap to some extent, with the lowest income being in informal wage labour, followed by self-employment, followed by formal sector income. Figure 5.1.8 presents the kernel densities of the logs of informal wage labour, informal self-employment, and formal income respectively. As can be seen, informal wage-labour income is distributed to the left, informal self-employment income is in the middle, and formal income is to the right of the other distributions. There is some overlap at the lower tails of the distributions, but self-employment and formal incomes have tails spread out at the higher income levels<sup>7</sup>.

A Kolmogorov-Smirnov test reveals that there are significant differences in these kernel densities. (All pair-wise Kolmogorov-Smirnov tests are statistically significant with a p-value of 0.000). Table 5.1.4 provides some summary statistics to illustrate the differences in the distribution of incomes. As discussed above, the mean (log) income in the formal sector is greater than that for the self-employed and that is greater than that for informal wage labour. The only curious result seems to be that the minimum of the formal sector is lower than that of the other two groups.

To be in the formal sector, domestic capitalists need to have significant amounts of capital and access to credit. Inheritance plays a large part in

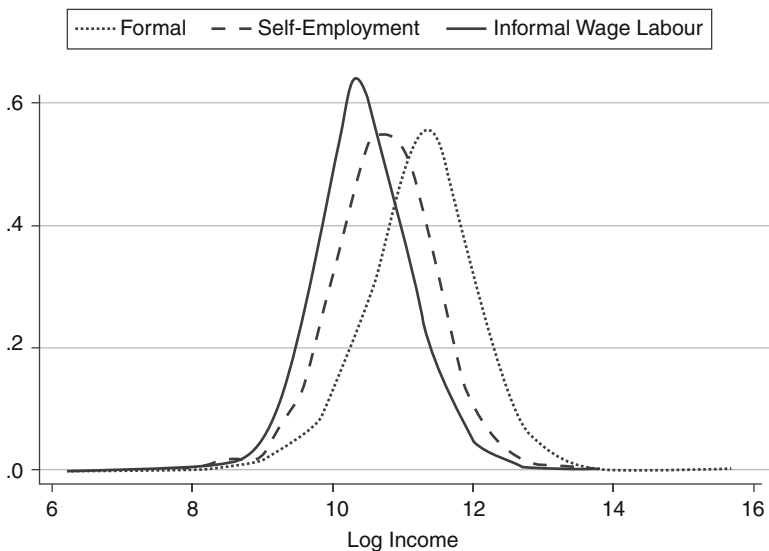


Figure 5.1.8 Kernel densities of log income by employment

*Table 5.1.4* Distribution of log incomes by sector

| Variable: log of income     | Obs. | Mean    | Std. Dev. | Min     | Max     |
|-----------------------------|------|---------|-----------|---------|---------|
| <b>Formal</b>               | 6916 | 11.2313 | 0.81603   | 6.21461 | 15.6904 |
| <b>Self-employment</b>      | 1324 | 10.7466 | 0.76783   | 6.8024  | 13.7695 |
| <b>Informal wage labour</b> | 3744 | 10.4617 | 0.70924   | 6.44883 | 13.731  |

*Source:* India Human Development Survey.

providing either the original capital or access to credit. Multinationals come in with large amounts of capital with technology that is labour saving (embodied technological change). Employment in the formal sector is then limited by the use of imported technology and limited amounts of capital. Note that only a limited amount of labour-capital substitution is possible because of embodied technology.

Wages in the formal sector are fixed by the government (minimum wages), by unions or employers using efficiency wage ideas, or by multinational firms that constrain wages. Employers in the formal sector ration employment by using education/experience as an index of productivity, and using religion/caste as a signal for productivity (statistical discrimination). Given two people with the same education/skill levels, they would prefer a high caste Hindu to a low caste Hindu or a Muslim. Note: being in the formal economy is not a guarantee against poverty (see ILO 2002, p.31).

Informal sector employment is a residual; the lower the employment in the formal sector, the greater the number who look for work in the informal sector, and hence, the lower the wages (income) for this sector.

Figure 5.1.9 below shows that 43% of the self-employed have taken out loans for business purposes, compared to only 14% in the formal sector and 16% in the informal wage labour group. It is clear that the self-employed have to take out loans for setting up and running a small enterprise. Presumably many of the informal wage workers would be interested in setting up a small business but are unable to access credit.

To summarise this section, we argue that households have a lexicographic preference ordering over the different outcomes, formal, self-employment, or informal wage labour. Migrants, especially rural migrants, have little access to credit or to the formal labour market, at least until they have spent some years in the urban sector.

## 5 Probability of working in the informal sector

In this section we estimate the probability of a household head working in the informal wage employment sector to be self-employed or in the formal sector. As discussed earlier, we make three hypotheses. One is that those households that come from the lower social classes/groups are more likely to



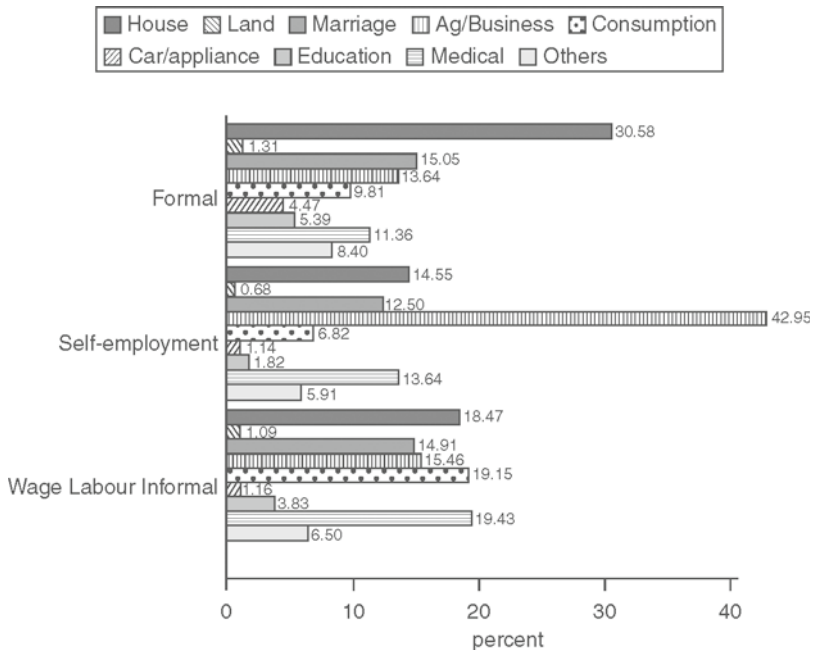


Figure 5.1.9 Purpose of loan by sector

be working in the informal sector. Some of these households may have the entrepreneurial skills or have access to small amounts of capital to set up as self-employed workers. We also hypothesise that households coming from higher social classes/groups, and/or that have higher levels of education are more likely to be working in the formal sector. Further we hypothesise that migrants who come into the urban areas would initially find employment in the informal sector and after some time, when they have accumulated sufficient funds or developed social networks or skills, are more likely to move into the formal sector. In our analysis below we regard migrants as those whose origin is in a rural area. Individuals who have come from other urban areas are regarded as 'urban natives'. We hypothesise that the duration of migration from a rural origin influences the sector of employment.

### 5.1 Econometrics and identification strategy

The fundamental challenge of estimating the causal impact of migration duration on the probability of working in the informal sector is the possibility of unobserved individual characteristics that might influence the migration decision, survival in a migration destination, and the duration as well as the likelihood of working in the informal sector. For example, it might be

possible that individuals with unobserved high ability or entrepreneurial skills might opt to move out of the rural area early in their life and remain in the urban area, and such unobserved skills and ability will also influence their choice of sector in the migration destination. Without controlling for this, estimation may be biased and inconsistent.

If we had panel data, we could have used methods to control for individual heterogeneity. Another ideal method that could be used to disentangle such unobserved influences on migration duration and job status would be by using some natural experimental framework or by randomly inducing people to migrate out of rural areas to estimate the causal impact of migration on job choice. Lacking the availability of such methods, we need to opt for an instrumental variable approach (IV) where we can instrument migration duration with a set of variables which do not have a direct influence on job placement or current job status.

One recent method to instrument for migration is using the historic migration rate as an instrument for current migration status (for example, see Woodruff and Zenteno 2007, Hanson and Woodruff 2003, McKenzie and Rapoport 2007, 2011, López-Córdoba 2005, and Hildebrandt and McKenzie 2005). Following the methodology of these influential works, we have used the historic state-level migration rates as an instrument for current migration duration. In particular, we use the Indian migration rates from data collected in the 1991 census at the state level and use this variable as an instrument in which the household is currently located.

It can be argued that these historic migration rates are the result of the massive development of railroads and other transportation systems in India coupled with the rapid economic expansion of large cities which created extended job demand. These historic migration rates can also be considered as signals of migration friendliness, of strong migration networks that can effectively lower the cost of migration for future potential migrants and increase the chances of their survival. These signals and networks become self-perpetuating, and as a result, continue to influence the migration decisions of households today.

Our identifying assumption is that historic state-level migration rates do not affect the current job placement of the individuals, apart from their influence through current migration. Instrumental variables estimation relies on this exogeneity assumption, and so it is important to consider and counteract potential threats to its validity.

One potential threat is that the historic level of inequality and lower economic class (lower caste and religious groups) could induce the historic migration rate, and that they are also influencing the current rate due to inter-generational transition. To tackle these potential pitfalls, we also used interaction terms of historic migration rate with the caste dummies as additional instruments. We have also controlled for city, district and state level fixed effects to control for spatial differences and location preferences, and report our results based on robust standard errors clustered at the individual level.

An alternative set of instruments would be to use the state level growth rates of GDP as this would capture the potential pull factor of migration<sup>8</sup>. The idea of this instrumental variable is deep-rooted in the history of Indian economic development and generated with the aim to capture the post-liberalization of India in 1992. Since state-level GDP has large heterogeneity, migration decisions of individuals would be based on comparing likely destinations with income potentialities, therefore could act as an instrument. As a robustness check, we have reported regression estimates based on the alternative instrumental variable in all result tables. To increase the precision of our estimation, we also estimated the equations using the additional set of instruments by employing the state-level GDP growth rate of India in 1994 interacted with caste dummies.

As our main outcome of interest is whether migrants use the informal sector as their temporary base (like a stepping stone), we studied the impact of migration duration of individuals on their placement in the informal sector. The reduced form IV approach consists of estimating a two-stage model of the following form, where  $I_j$  is the outcome variable of interest (individual  $j$ 's current employment sector),  $M_{jk}$  is individual  $j$ 's migration duration, and who is currently staying in State  $k$  (years of migration since originally migrating), and  $Z_k$  is the set of instrumental variables. Hence the reduced-form first stage equation for migration  $M_{jk}$  following Amemiya (1978), would be:

$$M_{jk}^* = \beta_0 + \beta_1 Z_k + \beta_2 X_{jk} + \gamma_k^m + \epsilon_{jk}^m, \quad (1)$$

$$M_{jk} = \begin{cases} M_{jk}^*, & \text{if } M_{jk}^* > M_0 \\ 0, & \text{if } M_{jk}^* \leq M_0 \end{cases},$$

and the equation for employment in the informal sector  $I_{jk}$  is

$$I_{jk}^* = \alpha_0 + \alpha_1 M_{jk} + \beta_2 X_{jk} + \gamma_k^i + \epsilon_{jk}^i, \quad (2)$$

$$I_{jk} = \begin{cases} 1, & \text{if } I_{jk}^* < I_0 \\ 0, & \text{if } I_{jk}^* \geq I_0 \end{cases}.$$

Here  $M_{jk}^*$  is the latent variable for migration decision, and  $M_{jk}$  is the observed years of migration duration to the current state  $k$  from the time individual  $j$  decided to migrate to state  $k$  by comparing the costs and benefits using a net benefit function or latent index expressed in equation (1). Similarly,  $I_{jk}^*$  is the latent job placement and  $I_{jk}$  is the dummy of job placement in the formal and informal sectors for the same individual  $j$  living in state  $k$  which can be seen arising by comparing the job qualifications and job related network information (such as informal or formal referral system) required for the job placement expressed in equation (2). In this setup the first dependent variable,  $M_{jk}$ , appears in the second equation as an endogenous variable. Here,  $X_{jk}$  includes the following set of controls: personal and household

characteristics, family background information, family composition information and dependency ratio (the number of children and old aged persons as a proportion of the household size)<sup>9</sup>, religion, and a dummy variable indicating whether or not the person is an urban native (the dummy is equal to one if the individual  $i$  who currently resides in state  $k$  is born in an urban area and zero if the person is a rural-to-urban migrant). Personal characteristics include age, age<sup>2</sup>, sex, education and marital information, whereas household characteristics include wealth status of the household which has been constructed using the principal component analysis of the household non-durable assets<sup>10</sup>. Dependency ratio of the household is also controlled for, which is the number of children and old aged persons as a proportion of household size<sup>11</sup>. Family background information contains variables on father's education and occupation history.  $\gamma_k^M$  and  $\gamma_k^I$  are unmeasured determinants of  $M_{ik}$  (e.g., migrant's own community network) and  $I_{ik}$  which is fixed at the state level (e.g., state's specialization in a particular occupational sector).  $M_0$  and  $I_0$  are unknown thresholds. Finally,  $\epsilon_{ik}^M$  and  $\epsilon_{ik}^I$  are non-systematic errors which follow  $E(\epsilon_{ik}^M | X_{ik}, Z_k, \gamma_k^M) = 0$  and  $(\epsilon_{ik}^I | X_{ik}, \gamma_k^I) = 0$ .

Given the setup of binary outcomes with a continuous endogenous variable, we use maximum-likelihood to estimate a multivariate probit model, which we will refer to by following the common practice of mentioning it as a IV-Probit model<sup>12</sup>.

## 5.2 Estimation

As discussed above we estimated a limited-information maximum-likelihood model for the probability of an individual being in the informal sector as a function of the duration of migration (for rural-to-urban migrants), demographic characteristics, household characteristics, religion and family background information, shown in Table 5.1.5. In addition we included state, district and city-level fixed effects to capture unobserved geographical and regional impacts on an individual's job placement in the informal sector. Robust standard errors at the individual level are employed for all regressions to derive statistical inference. Columns (1)–(4) depict the estimations using historic migration rate based IV whereas Columns (5)–(8) used the economic growth based IV to show the consistency of our estimations. For robustness check of our estimations, we used full sample (columns 1–2 and columns 5–6) as well as male only sub-samples, (columns 3–4 and columns 7–8). In all regressions, using different sub-samples and different IVs, our results are largely consistent and none of the variables changed sign. We reported the marginal effects of all estimations in columns (2), (4), (6) and (8) respectively. To show consistency in our estimation, we have also estimated a simple probit model without treating the duration of migration as endogenous, shown in column (9). The probit result shows a small and negative but statistically insignificant impact of migration duration on

Table 5.1.5 IV-Probit estimates of the probability for informal sector employment

| Dependent Variable:<br>Employment at<br>Informal sector | IV1: Historical migration rate: state level |                      | IV2: Economic growth of 94: State level |                      | Simple probit        |                      |
|---------------------------------------------------------|---------------------------------------------|----------------------|-----------------------------------------|----------------------|----------------------|----------------------|
|                                                         | Full sample                                 |                      | Male only                               |                      | Male only            |                      |
|                                                         | (1)<br>Coefficient                          | (2)<br>M.E.          | (3)<br>Coefficient                      | (4)<br>M.E.          | (5)<br>Coefficient   | (6)<br>M.E.          |
| Migration duration                                      | -0.073***<br>(0.016)                        | -0.028***<br>(0.006) | -0.073***<br>(0.018)                    | -0.028***<br>(0.007) | -0.073**<br>(0.032)  | -0.028**<br>(0.013)  |
| Urban Native                                            | -0.512***<br>(0.085)                        | -0.187***<br>(0.031) | -0.517***<br>(0.096)                    | -0.190***<br>(0.035) | -0.511***<br>(0.164) | -0.188***<br>(0.060) |
| No. of Households                                       | 0.032***<br>(0.009)                         | 0.012***<br>(0.003)  | 0.033***<br>(0.010)                     | 0.013***<br>(0.004)  | 0.033**<br>(0.013)   | 0.013***<br>(0.005)  |
| Married                                                 | 0.108<br>(0.102)                            | 0.041<br>(0.038)     | 0.081<br>(0.110)                        | 0.031<br>(0.042)     | 0.079<br>(0.111)     | 0.030<br>(0.042)     |
| Primary Education                                       | -0.135**<br>(0.063)                         | -0.051**<br>(0.023)  | -0.077<br>(0.066)                       | -0.029<br>(0.025)    | -0.076<br>(0.069)    | -0.029<br>(0.026)    |
| Secondary Education                                     | -0.306***<br>(0.062)                        | -0.114***<br>(0.022) | -0.268***<br>(0.067)                    | -0.101***<br>(0.024) | -0.267***<br>(0.083) | -0.101***<br>(0.025) |
| Matric Completed                                        | -0.562***<br>(0.081)                        | -0.201***<br>(0.024) | -0.547***<br>(0.086)                    | -0.198***<br>(0.027) | -0.549***<br>(0.125) | -0.199***<br>(0.037) |
| Tertiary Education                                      | -0.716***<br>(0.101)                        | -0.246***<br>(0.026) | -0.700***<br>(0.109)                    | -0.243***<br>(0.029) | -0.700***<br>(0.167) | -0.244***<br>(0.044) |
| Graduate                                                | -0.958***<br>(0.121)                        | -0.335***<br>(0.033) | -0.953***<br>(0.131)                    | -0.337***<br>(0.037) | -0.954***<br>(0.211) | -0.337***<br>(0.058) |
| High caste                                              | 0.101*<br>(0.052)                           | 0.039*<br>(0.020)    | 0.092*<br>(0.054)                       | 0.036*<br>(0.021)    | 0.093*<br>(0.055)    | 0.036*<br>(0.021)    |
| OBC                                                     | 0.119**<br>(0.056)                          | 0.046**<br>(0.022)   | 0.122**<br>(0.058)                      | 0.047**<br>(0.023)   | 0.125*<br>(0.067)    | 0.049*<br>(0.026)    |
| Dalit                                                   | 0.015<br>(0.056)                            | 0.006<br>(0.022)     | -0.009<br>(0.059)                       | -0.004<br>(0.023)    | -0.005<br>(0.059)    | -0.002<br>(0.023)    |

(continued)

Table 5.1.5 Continued

| Dependent Variable:<br>Employment at<br>Informal sector | IV1: Historical migration rate: state level |                     |                    |                     | IV2: Economic growth of 94: State level |                     |                    |                    | Simple probit |                     |
|---------------------------------------------------------|---------------------------------------------|---------------------|--------------------|---------------------|-----------------------------------------|---------------------|--------------------|--------------------|---------------|---------------------|
|                                                         | Full sample                                 |                     | Male only          |                     | Full sample                             |                     | Male only          |                    | (8)<br>M.E.   | (9)<br>Coefficient  |
|                                                         | (1)<br>Coefficient                          | (2)<br>M.E.         | (3)<br>Coefficient | (4)<br>M.E.         | (5)<br>Coefficient                      | (6)<br>M.E.         | (7)<br>Coefficient | (8)<br>M.E.        |               |                     |
| Adivasi                                                 | -0.185**<br>(0.090)                         | -0.069**<br>(0.033) | -0.180*<br>(0.095) | -0.068**<br>(0.035) | -0.181**<br>(0.091)                     | -0.068**<br>(0.033) | -0.177*<br>(0.097) | -0.067*<br>(0.035) |               | -0.195**<br>(0.098) |
| Muslim                                                  | 0.171**<br>(0.073)                          | 0.067**<br>(0.028)  | 0.191**<br>(0.076) | 0.075**<br>(0.030)  | 0.175**<br>(0.088)                      | 0.068**<br>(0.034)  | 0.195*<br>(0.100)  | 0.077**<br>(0.039) |               | 0.297***<br>(0.065) |
| Sikh, Jain                                              | 0.086<br>(0.100)                            | 0.033<br>(0.039)    | 0.049<br>(0.104)   | 0.019<br>(0.041)    | 0.088<br>(0.105)                        | 0.034<br>(0.041)    | 0.051<br>(0.115)   | 0.020<br>(0.045)   |               | 0.168<br>(0.105)    |
| Christian                                               | -0.055<br>(0.112)                           | -0.021<br>(0.043)   | -0.074<br>(0.119)  | -0.028<br>(0.045)   | -0.053<br>(0.114)                       | -0.020<br>(0.043)   | -0.072<br>(0.120)  | -0.028<br>(0.046)  |               | -0.106<br>(0.120)   |
| Dependency Ratio                                        | -0.120*<br>(0.067)                          | -0.046*<br>(0.026)  | -0.121*<br>(0.071) | -0.047*<br>(0.028)  | -0.117*<br>(0.067)                      | -0.045*<br>(0.026)  | -0.116<br>(0.072)  | -0.045<br>(0.028)  |               | -0.104<br>(0.073)   |
| City Dummies                                            | Yes                                         | Yes                 | Yes                | Yes                 | Yes                                     | Yes                 | Yes                | Yes                | Yes           | Yes                 |
| District Dummies                                        | Yes                                         | Yes                 | Yes                | Yes                 | Yes                                     | Yes                 | Yes                | Yes                | Yes           | Yes                 |
| State Dummies                                           | Yes                                         | Yes                 | Yes                | Yes                 | Yes                                     | Yes                 | Yes                | Yes                | Yes           | Yes                 |
| Observations                                            | 10,521                                      | 10,521              | 9,668              | 9,668               | 10,485                                  | 10,485              | 9,641              | 9,641              | 10521         | 10521               |
| Log pseudolikelihood                                    | -42610                                      | -42610              | -38930             | -38930              | -42490                                  | -42490              | -38842             | -38842             | -5704         | -5704               |
| chi2                                                    | 133216                                      | 133216              | 12254              | 12254               | 3407                                    | 3407                | 3169               | 3169               | 2259          | 2259                |
| F-Statistics at First Stage                             | 26.91                                       |                     | 25.44              |                     | 26.83                                   |                     | 37.69              |                    |               |                     |
| Wald test of exogeneity                                 | 14.66***                                    | 14.66***            | 13.31***           | 13.31***            | 4.814**                                 | 4.814**             | 2.805**            | 2.805**            |               |                     |

Source: Indian Human Development Survey 2005: Authors' own calculations.

Notes: Robust standard errors in parentheses. Significance code: \*p<0.1, \*\*p<0.05, \*\*\*p<0.01. M.E. Stands for Marginal Effects which have been calculated at the mean. In all these specifications, we are considering only those as migrant who have migrated from rural to urban areas for jobs. Those who were born in urban setup and migrated to another urban area for job are not considered as migrants. In the regression we also control for head of the households age, age squared, sex, asset status and father's education and occupation.

probability of someone being in the informal sector. Once we instrument for migration duration in columns (1)–(8), however, this effect becomes larger and statistically more significant. This result implies that the longer the migrant is staying in the urban areas, the more likely s/he is to find an employment in the formal sector, as the person could acquire experience, networks and skill-sets which could be instrumental in getting a job in the formal sector. Given the fact that some migrants have already returned back after realizing their negligible probability of securing a formal employment in the urban areas, those who remained in the urban areas, prefer formal employment more than the non-migrants and our results show that each additional year of migration time-length increases the probability of being in the formal sector significantly.

We would expect the higher the education of an individual, the lower the probability of belonging to the informal sector. Our estimations, see Table 5.1.5, show clearly that the higher the level of education of the household head the lower the probability of being in the informal sector, and the coefficients get smaller (bigger in absolute value) respectively. The results for father's education are very similar to the household head's education level. Further, we would expect that if the father of the individual were of a higher social class (in terms of occupation), the probability of being in the informal sector would be lower. Again the evidence supports the view that the parent's occupation clearly influences an individual's employment placement: if the father's occupation is formal in nature like executive or clerk, the probability of being in the informal sector is lower, while if the father's occupation is sales (which is mostly informal in nature in the Indian context), then there is a higher probability of being in the informal sector. As discussed earlier, we would expect a person from a socially disadvantaged caste or religion more likely to be in the informal sector. Our findings show that OBC (Other Backward Classes) and Muslims are more likely to be in the informal sector. We did not find any statistical significance for Dalits (the lower social castes) in the informal sector compared with Brahmins, which may be attributable to the government's positive discrimination in employment in the government sector (reservation system) for Dalits. As we would expect, the wealthier the household head, the less likely s/he would be in the informal sector. We found that dependency ratio is weakly significant and the sign is negative, suggests that a higher dependency ratio would lead the person transition out of the informal sector into the formal sector as the person would be willing to accept any formal sector job offer which enables better security, however, such an issue appears to be not very influential in explaining the probability of being in the informal sector.

Our results suggest that urban natives are more likely to be in the formal sector as they have more access to better schools, social networks and job information and referrals compared with the rural-to-urban migrants. Our main variable of interest is rural migration duration. In all cases it is negative and significant at the 1% level. In other words, the longer a rural migrant has been in

an urban area the more likely that individual would have moved to the formal sector. (Note the rural migration duration variable has been instrumented).

The validity of IV estimations depends on the power of instruments in explaining the predicted values at the first stage. As reported, all the first stage regressions have very high F-statistics (for example, for our preferred specification of column 1, the first stage F-statistic is 26.91). We have also tested for the joint significance of our IVs, and the results overwhelmingly reject the null of no joint significance. The Wald statistic of the exogeneity test has rejected the null hypothesis of no endogeneity. We have also tested the instruments using the typical 2SLS models to test for the over-identification test (Anderson canonical correlations test) and under-identification test (Sargan-Hansen test) which have duly supported our instruments.

## 6.0 Multinomial estimation (Formal, self-employed and Informal wage)

In this section we have separated the informal sector into those who are self-employed and those who work in the informal or formal sectors as wage labourers to check whether or not highly qualified individuals are employed in the formal sector and also to check if migrants use the informal sector as their temporary base. We did this check by employing a multinomial logit job attainment model following the work of Xin Meng (2001).

### 6.1 Econometric modelling

Standard neo-classical economic rationality for an individual's job placement (labour supply) is a function of individual endowments and human resources (e.g., level of education and experience). However, other related factors that could also have an impact on an individual's labour supply, especially in the context of India, could be the family size (Brown et al. 1980), family background, caste and religious affiliation (see for example Banerjee and Knight 1985, or Ito 2009). Another less frequently studied factor that might be critical is the job related network, for example, job-opening information, formal and informal channels of job search and referral (see for example Holzer 1987 or Calvó-Armengol and Zenou 2005). Since urban natives usually have a better endowment of job-related networks and referrals, we could hypothesise that migrants will acquire access to such networks as their migration duration increases and hence are less likely to be in informal wage labour.

A multinomial logit model is specified below to capture how these variables will influence an individual  $j$ 's probability of working in sector  $s$ . Formally the model is:

$$P_{js} = \text{prob}(y_j = \text{sector}_s) = \frac{e^{x_j' \beta_s}}{\sum_{s=1}^S e^{x_j' \beta_s}} \quad j = 1, \dots, N; s = 1, \dots, S. \quad (3)$$



where  $N$  is the size of the sample,  $S$  is the number of sectors and  $x_j$  is a vector of variables affecting the labour placement outcome  $y_j$ . The dependent variable  $y_j$  for equation (3) is the nature of an individual's current job in any of the three sectors: formal sector, self-employment or informal wage labour sector. Our main variable of interest, years of migration duration, is endogenous in nature. Hence to allow for the endogeneity in estimating equation (3), we first used the fitted value of migration duration using all the instruments (estimation done through OLS). In the second step we used the fitted value of the migration duration in equation 3. The standard errors of the estimates in the second step have been estimated through a bootstrapping process with 100 replications.

## 6.2 Estimations

The results of marginal effects of endogenous multinomial probit estimations are reported in Table 5.1.6 with full sample and in Table 5.1.7 with male only sub-sample. The dependent variable has been categorized into three groups with formal sector employment being used as a base category. Columns (1)–(3) report the estimations using the historic migration rate as an IV whereas columns (4)–(6) are estimated employing state-level economic growth of 1994 as IV.

Tables 5.1.6 and 5.1.7 are broadly similar to those reported in Section 5 of the IV-probit model (Table 5.1.5). For both the self-employed and informal wage labour sectors, education, father's characteristics, and the caste and religion coefficients have essentially the same signs and significance. The main point of difference is that a rural migrant's duration of migration does not significantly influence the probability of being in the self-employed sector, but is negative and significant for the informal wage labour sector and positive and significant for formal employment. In other words, we find that the longer a rural migrant has been in the urban sector the less likely he would be in informal wage employment and more likely to be in the formal sector. For instance, an individual with one additional year's of migration duration from the rural area reduces his/her probability to be in informal wage employment by 2.9% and increases the probability of being in the formal employment by about 3%. However, this variable has no statistically discernible effect on him/her being in the self-employed sectors. Results on education are consistent with the other findings that with more years of education, individuals will less likely be in the informal sector and more likely to be in the formal sector. In the case of self-employment, education up to the tertiary level does not have any statistically significant impact; however, for above tertiary level education, the probability of someone being in self-employed sector is significantly reduced.

The validity of multinomial regression lies on the strong assumption of the Independence of Irrelevant Alternatives (IIA), which means that adding or deleting alternative outcome categories does not affect the odds among

Table 5.1.6 Marginal effects of multinomial logit regression (full sample)

| Variables    | IV1: Historic migration rate:<br>state level |                    |                         | IV2: Economic growth of 94:<br>state level |                    |                         |
|--------------|----------------------------------------------|--------------------|-------------------------|--------------------------------------------|--------------------|-------------------------|
|              | Full sample                                  |                    |                         | Full sample                                |                    |                         |
|              | (1)                                          | (2)                | (3)                     | (4)                                        | (5)                | (6)                     |
|              | Formal                                       | Self<br>employment | Informal<br>wage labour | Formal                                     | Self<br>employment | Informal<br>wage labour |
| Migration    | 0.0305***                                    | -0.00154           | -0.0290***              | 0.0255**                                   | -0.00428           | -0.0212**               |
| Duration     | (0.00993)                                    | (0.00719)          | (0.00877)               | (0.0124)                                   | (0.00804)          | (0.00962)               |
| Urban Native | 0.190***                                     | -0.0206            | -0.169***               | 0.170***                                   | -0.0328            | -0.137***               |
|              | (0.0470)                                     | (0.0371)           | (0.0364)                | (0.0600)                                   | (0.0400)           | (0.0420)                |
| No. of       | -0.0150***                                   | 0.00247            | 0.0126***               | -0.0152***                                 | 0.00240*           | 0.0128***               |
| Households   | (0.00302)                                    | (0.00175)          | (0.00255)               | (0.00312)                                  | (0.00140)          | (0.00277)               |
| Married      | -0.0322                                      | -0.0219            | 0.0541*                 | -0.0267                                    | -0.0196            | 0.0463                  |
|              | (0.0427)                                     | (0.0305)           | (0.0320)                | (0.0527)                                   | (0.0340)           | (0.0388)                |
| Primary      | 0.0319                                       | 0.0308             | -0.0627***              | 0.0323                                     | 0.0310             | -0.0633***              |
| Education    | (0.0266)                                     | (0.0209)           | (0.0164)                | (0.0273)                                   | (0.0202)           | (0.0155)                |
| Secondary    | 0.0972***                                    | 0.0208             | -0.118***               | 0.0971***                                  | 0.0200             | -0.177***               |
| Education    | (0.0213)                                     | (0.0167)           | (0.0137)                | (0.0191)                                   | (0.0144)           | (0.0125)                |
| Matric       | 0.181***                                     | -0.00272           | -0.178***               | 0.181***                                   | -0.00319           | -0.178***               |
| Completed    | (0.0193)                                     | (0.0151)           | (0.0124)                | (0.0184)                                   | (0.0137)           | (0.0114)                |
| Tertiary     | 0.220***                                     | -0.0139            | -0.206***               | 0.220***                                   | -0.0138            | -0.206***               |
| Education    | (0.0197)                                     | (0.0162)           | (0.0108)                | (0.0176)                                   | (0.0138)           | (0.00948)               |
| Graduate     | 0.339***                                     | -0.0454***         | -0.293***               | 0.339***                                   | -0.0457***         | -0.293***               |
|              | (0.0192)                                     | (0.0134)           | (0.0151)                | (0.0166)                                   | (0.0116)           | (0.0132)                |
| High caste   | -0.0474*                                     | 0.0254             | 0.0220                  | -0.0463*                                   | 0.0265*            | 0.0198                  |
|              | (0.0256)                                     | (0.0169)           | (0.0215)                | (0.0260)                                   | (0.0145)           | (0.0248)                |
| OBC          | -0.0659***                                   | 0.0290**           | 0.0369**                | -0.0685***                                 | 0.0283*            | 0.0403*                 |
|              | (0.0208)                                     | (0.0145)           | (0.0178)                | (0.0244)                                   | (0.0158)           | (0.0211)                |
| Dalit        | -0.00897                                     | -0.0369***         | 0.0458**                | -0.0104                                    | -0.0371***         | 0.0475**                |
|              | (0.0233)                                     | (0.0123)           | (0.0207)                | (0.0237)                                   | (0.0118)           | (0.0219)                |
| Adivasi      | 0.0664*                                      | -0.0315            | -0.0348                 | 0.0635*                                    | -0.0321*           | -0.0315                 |
|              | (0.0339)                                     | (0.0193)           | (0.0277)                | (0.0360)                                   | (0.0186)           | (0.0340)                |
| Muslim       | -0.0945***                                   | 0.0305             | 0.0640***               | -0.101***                                  | 0.0277             | 0.0732***               |
|              | (0.0282)                                     | (0.0190)           | (0.0231)                | (0.0288)                                   | (0.0214)           | (0.0273)                |
| Sikh, Jain   | -0.0391                                      | 0.0342             | 0.00493                 | -0.0425                                    | 0.0321             | 0.0105                  |
|              | (0.0464)                                     | (0.0307)           | (0.0473)                | (0.0463)                                   | (0.0317)           | (0.0467)                |
| Christian    | 0.0301                                       | -0.0680***         | 0.0379                  | 0.0334                                     | -0.0674***         | 0.0340                  |
|              | (0.0479)                                     | (0.0234)           | (0.0457)                | (0.0441)                                   | (0.0194)           | (0.0417)                |
| Dependency   | 0.0524*                                      | -0.0244            | -0.0279                 | 0.0485*                                    | -0.0262*           | -0.0223                 |
| Ratio        | (0.0286)                                     | (0.0158)           | (0.0244)                | (0.0291)                                   | (0.0153)           | (0.0222)                |
| Observations | 10,521                                       | 10,521             | 10,521                  | 10,485                                     | 10,485             | 10,485                  |

Source: Indian Human Development Survey 2005: Authors' own calculations.

Notes: Robust standard errors in parentheses. The standard errors of the estimates in the second step have been estimated through a bootstrapping process with 100 replications. Significance code: \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ . In all these specifications, we are considering only those as migrant who have migrated from rural to urban areas for jobs. Those who were born in urban setup and migrated to another urban area for job are not considered as migrants.

In the regression we also control for head of the households age, age squared, sex, asset status and father's education and occupation. All regressions controlled for district, state and city fixed effects as well.

Table 5.1.7 Marginal effects of multinomial logit regression (male only sample)

| Variables           | IV1: Historic migration rate:<br>state level |                        |                         | IV2: Economic growth of 94:<br>state level |                        |                         |
|---------------------|----------------------------------------------|------------------------|-------------------------|--------------------------------------------|------------------------|-------------------------|
|                     | Full sample                                  |                        |                         | Full sample                                |                        |                         |
|                     | (1)                                          | (2)                    | (3)                     | (4)                                        | (5)                    | (6)                     |
|                     | Formal                                       | Self-<br>employment    | Informal<br>wage labour | Formal                                     | Self-<br>employment    | Informal<br>wage labour |
| Migration           | 0.0306**<br>(0.0119)                         | 0.00113<br>(0.00805)   | -0.0317***<br>(0.00925) | 0.0235*<br>(0.0138)                        | -0.00190<br>(0.00845)  | -0.0216**<br>(0.0105)   |
| Duration            | 0.190***<br>(0.0574)                         | -0.00916<br>(0.0437)   | -0.181***<br>(0.0359)   | 0.163**<br>(0.0675)                        | -0.0229<br>(0.0440)    | -0.140***<br>(0.0460)   |
| Urban Native        | -0.0162***<br>(0.00335)                      | 0.00251<br>(0.00180)   | 0.0137***<br>(0.00272)  | -0.0166***<br>(0.00366)                    | 0.00235<br>(0.00196)   | 0.0143***<br>(0.00307)  |
| No. of Households   | -0.0223<br>(0.0448)                          | -0.0238<br>(0.0351)    | 0.0462<br>(0.0340)      | -0.0171<br>(0.0559)                        | -0.0226<br>(0.0403)    | 0.0396<br>(0.0393)      |
| Married             | 0.00532<br>(0.0272)                          | 0.0435**<br>(0.0219)   | -0.0488***<br>(0.0153)  | 0.00467<br>(0.0328)                        | 0.0450*<br>(0.0251)    | -0.0497***<br>(0.0186)  |
| Primary Education   | 0.0827***<br>(0.0241)                        | 0.0257<br>(0.0181)     | -0.108***<br>(0.0152)   | 0.0815***<br>(0.0262)                      | 0.0266<br>(0.0190)     | -0.108***<br>(0.0158)   |
| Secondary Education | 0.178***<br>(0.0219)                         | -0.000493<br>(0.0169)  | -0.177***<br>(0.0129)   | 0.177***<br>(0.0247)                       | -0.000998<br>(0)       | -0.176***<br>(0.0143)   |
| Matric Completed    | 0.217***<br>(0.0196)                         | -0.0108<br>(0.0163)    | -0.206***<br>(0.0121)   | 0.216***<br>(0.0231)                       | -0.0109<br>(0.0193)    | -0.205***<br>(0.0130)   |
| Tertiary Education  | 0.339***<br>(0.0208)                         | -0.0422***<br>(0.0141) | -0.297***<br>(0.0159)   | 0.339***<br>(0.0231)                       | -0.0438***<br>(0.0164) | -0.295***<br>(0.0160)   |
| Graduate            | -0.0423*<br>(0.0232)                         | 0.0254*<br>(0.0147)    | 0.0170<br>(0.0215)      | -0.0407<br>(0.0250)                        | 0.0272<br>(0.0167)     | 0.0136<br>(0.0249)      |
| High caste          | -0.0658***<br>(0.0208)                       | 0.0315**<br>(0.0157)   | 0.0342<br>(0.0217)      | -0.0685**<br>(0.0288)                      | 0.0315**<br>(0.0151)   | 0.0370<br>(0.0250)      |
| OBC                 | 0.00337<br>(0.0255)                          | -0.0401***<br>(0.0122) | 0.0367<br>(0.0242)      | 0.00249<br>(0.0271)                        | -0.0422***<br>(0.0139) | 0.0397<br>(0.0271)      |
| Dalit               | 0.0668*<br>(0.0374)                          | -0.0257<br>(0.0216)    | -0.0411<br>(0.0305)     | 0.0646<br>(0.0447)                         | -0.0273<br>(0.0228)    | -0.0373<br>(0.0372)     |
| Adivasi             | -0.104***<br>(0.0326)                        | 0.0362<br>(0.0227)     | 0.0674**<br>(0.0307)    | -0.110***<br>(0.0331)                      | 0.0344*<br>(0.0204)    | 0.0761**<br>(0.0316)    |
| Muslim              | -0.0211<br>(0.0409)                          | 0.0373<br>(0.0308)     | -0.0162<br>(0.0435)     | -0.0273<br>(0.0473)                        | 0.0350<br>(0.0292)     | -0.00766<br>(0.0437)    |
| Sikh, Jain          | 0.0387<br>(0.0923)                           | -0.0723<br>(0.116)     | 0.0336<br>(0.0557)      | 0.0413<br>(0.0729)                         | -0.0747<br>(0.0766)    | 0.0335<br>(0.0534)      |
| Christian           | 0.0526**<br>(0.0259)                         | -0.0272<br>(0.0171)    | -0.0254<br>(0.0244)     | 0.0482*<br>(0.0280)                        | -0.0292*<br>(0.0156)   | -0.0189<br>(0.0243)     |
| Ratio               | 9,668                                        | 9,668                  | 9,668                   | 9,641                                      | 9,641                  | 9,641                   |
| Observations        |                                              |                        |                         |                                            |                        |                         |

Source: Indian Human Development Survey 2005: Authors' own calculations.

Notes: Robust standard errors in parentheses. The standard errors of the estimates in the second step have been estimated through a bootstrapping process with 100 replications. Significance code: \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ . In all these specifications, we are considering only those as migrant who have migrated from rural to urban areas for jobs. Those who were born in urban setup and migrated to another urban area for job are not considered as migrants. In the regression we also control for head of the households age, age squared, sex, asset status and father's education and occupation. All regressions controlled for district, state and city fixed effects as well.

the remaining outcomes. To check whether this assumption holds in our case, we have performed the test for the IIA assumption, and we find no evidence violating the assumption (using the full-sample specification of Table 5.1.6).

## 7 Conclusions

In our paper we have defined migrants as those individuals who have migrated from rural to urban areas. Those who were born in urban areas and migrated to another urban area are not considered as migrants<sup>13</sup>. Also note that in our multinomial logit regressions, for the sake of simplicity of estimation, we used only the rural-to-urban migration duration as endogenous and properly took care of such endogenous regression by using instruments to predict the fitted value of the variable and plugged in the fitted value in the final multinomial regression. One could argue, however, that urban-to-urban migration could also be endogenous. We have also used urban-to-urban migration as endogenous in separate regression estimations in the multinomial logit framework (not reported) and in a linear probability model, and in both cases the variable was insignificant and did not appear to be influential in explaining the likelihood of a person's placement in the informal labour market.

We argued that Indian urban sector appears to have segmented labour markets: people who are from the lower social classes (castes or religions) are more likely to work in the informal sector. We found that getting more education is one way of getting a job in the formal sector, but perhaps more important are family networks in providing an entry into the formal labour market. We argued that when rural migrants move to the urban sector, they initially find themselves working in the informal sector where they have low incomes and mostly employed in industries like construction, manufacturing, wholesale and retail trades, restaurants and hotels, transport, and social and personal services. Their occupations are mainly in the lower social grades, such as production and related work, transport, sales and service work, and working as labourers. We noted that caste and religion play important roles for the employment and job placement as we see that Brahmins and high caste people are more likely to be in higher level occupations, whereas Dalits and Muslims is mostly employed in non-agricultural day-labour or as artisans.

We argued that there is a hierarchy of preferences that people would prefer to work in the formal sector, with the self-employed sector being the second choice, and lastly working in the informal wage labour market. However, entry into the formal sector is constrained by education, social class, and family ties. Self-employment is constrained by access to the credit market.

We estimated a model of the probability of working in the informal sector as a function of demographic characteristics, education, father's education and occupation, caste and religion, and duration of a migrant in his/her

present occupation. We distinguished between migrants who had come from rural areas from those who had moved from other urban areas. We treated the duration of the migrant as an endogenous variable and estimated a two-stage least-squares model. We found that most of the explanatory variables were significant and of the expected signs. In particular, we found that individual's own education as well as father's education and occupational status play significant role in the job placement equation. We also found that Muslims and Other Backward Classes were more likely to be working in the informal sector.

The most interesting finding of our research is that the length of time a rural migrant spends in the urban sector, the more likely s/he moves out of the informal wage sector. In other words, the duration of migration from rural areas is inversely related to the probability of working in the informal sector. This result implies that the longer the migrant is staying in the urban areas, the more likely s/he is to find an employment in the formal sector, as the person could capitalize on his acquired experience, networks and skill-sets due to the migration. Since formal employment provides job security, insurance and other facilities, getting a placement in the formal sector appears to be the more preferred option for migrants compared with non-migrants. If a migrant realizes that the probability of finding a formal job is really limited, then the person is more likely to return back to the origin quite early, after comparing the cost and benefits of holding back in the migration destination. As a result, amongst those who remained in the urban area, we find that each additional year of migration duration increases the probability of being in the formal sector for migrants by about 3%. Hence, the longer the duration in the urban sector the less likely is the migrant to be in the informal sector. The results support the view that for migrants, the informal wage labour market may be a stepping stone to a secured life in the formal sector.

However, using a cross-sectional data set to analyse migration and urban employment is a challenging task. Migrants have a higher attrition probability due to the mobility of the population. Hence, when a researcher is confronted with a migrant population, it is difficult to define the population at hand, as there are constant inflows and outflows of individuals with different traits. Moreover, duration raises the possibility of right censoring which could not be addressed with the data at hand. These results need to be researched further using panel data, which unfortunately are not available as yet.

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## Notes

1. For a detailed discussion about the concept and measurement of informality, see Perry et al. (2007). Also see Guha-Khasnobis et al. (2006).
2. Schneider et al. (2010) provide estimates of the size of 'shadow economies' for a range of countries. For India their estimate is an average of 22% for the period 1999–2006. This is based on macroeconomic estimates for a group of countries using the MIMIC method. However, their estimates rely on only 27 (or 20) degrees of freedom. As our research is primarily about the informal *labour* market we do not wish to enter into debates about different estimates of the share of the shadow (informal) economy in GDP.
3. A 'good' school would almost certainly be an established private school.
4. It has been suggested by McMillan and Rodrik (McMillan and Rodrik 2011) that in Latin America the rationalisation of some firms led to lower employment in the formal sector with the redundant workers moving to the lower productivity informal sector, hence average productivity fell.
5. Of course, some people may prefer informal sector activities, see Perry et al. (2007).
6. 'Indeed most of the informal salaried appear to be queuing for more desirable jobs in either the formal salaried sector or as self-employed workers...', p. 6, Perry et al. (2007).
7. Perry et al. (2007) has detailed information about Latin America. Alice Sindzingre (in Guha-Khasnobis et al. (2006) also points out that there is a huge variation in earnings and that informal business enterprises heads may have higher earnings than the average wage in the formal sector.
8. We thank an anonymous referee for suggesting this alternative instrument.
9. This variable ranks the value of non-durable assets from 1 to 6 Rank 1, the lowest, is households with a total value of non-durables of less than 500 rupees. Rank 6, the highest, is households with asset valued at more than 20,000 rupees. (On 12th March 2013 the exchange rate was: 100 INR=1.84 USD).
10. We thank an anonymous referee for suggesting this important control variable.
11. Estimations were carried out by using the IVProbit command with MLE option in STATA version 13.
12. Those who were born in other countries are not part of the sample in our estimations.

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**6**

# **Microfinance and Women's Empowerment**

# 6.1

## Factors Influencing Women's Empowerment on Microcredit Borrowers: A Case Study in Bangladesh

Sayma Rahman, P. N. Junankar and Girijasankar Mallik

*Women's empowerment in relation to microcredit programmes is a prominent issue in the literature of microcredit. Not only the founder of the Grameen Bank is awarded the 2006 Nobel Peace Prize on the microcredit programme of Bangladesh but it has also been a topic of great interest to researchers since its introduction in mid-1970s. This study views women's empowerment from an emancipation perspective. The study uses quasi-experimental approach to compare women's empowerment between microcredit borrowers and non-borrowers. Using control-group method (non-borrowers from non-programme villages), this study identifies factors that influence women's empowerment. It also examines the impact on women's empowerment of borrowers having different levels of income. Results show that non-borrowers are equally empowered as microcredit borrowers. It has also been found that age and education levels of women are significant factors in such an empowerment.*

### 1 Introduction

In recent years, microcredit programmes have received wider global attention targeting the poor in developing countries. Study conducted by United Nations (2004)<sup>1</sup> shows that more than one billion people around the world live below the poverty line, which particularly includes women and children of developing countries. They further emphasise that women's empowerment is a critical factor in eradicating women's poverty. Abed (2000) argues that women's economic emancipation is pivotal for alleviating poverty. In Bangladesh, over the last few decades, both microcredit institutions and

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non-government organisations (NGOs) have been contributing to break the cycle of poverty. One of the main features of both microcredit institutions and NGOs has been the overwhelming representation of women.

In relation to Bangladesh's traditional social structure, of which gender discrimination is a fundamental characteristic, Yunus (1999, p. 88) argues that, 'A poor woman in our society is totally insecure, she cannot read and write, and generally she has never been allowed out of her house to earn money, even if she has wanted to ...'. Also, it cannot be assumed that Bangladesh's women in the formal sector are liberated from discrimination. In Bangladesh society, where there is a power distance<sup>2</sup> between men and women, Yunus (1999, p. 87) argues that the formal procedures of obtaining loans are more difficult for women compared to men, as the banks require approval from the male spouse and/or male guardian.

There are general views that less educated, rural women are likely to be loyal and faithful. This is a reason why the microcredit institutions in Bangladesh have targeted women to provide loans. Of course, the ultimate objective for such a strategy is to alleviate women's poverty in order to empower them. In Bangladesh, 94% of microcredit borrowers are women and the recovery rate of loans is 98% (Grameen Bank Annual Report 2006). Since 1985, the Grameen Bank has been channelling credit to women. It has also been proved from the literature that household consumption increases by 18% when lending to women compared to 11% when lending to men (Khandker 1998). In this backdrop, it is worth examining women's empowering in microcredit programmes.

Studies on the impact of microcredit on women's empowerment suffer from negligence of problem arising from heterogeneity bias. This bias arises due to correlation between the credit variables and person-specific and village-specific unobserved determinants of empowerment. To avoid heterogeneity bias, this study does not look at the impact of microcredit on women's empowerment; rather it uses quasi-experimental approach by comparing women's empowerment between borrowers and non-borrowers. Since there are no two identical villages or households, again comparison studies will not give unbiased results. We have therefore, in this study, used control-group method by comparing microcredit borrowers with non-borrowers from non-programme villages. The uniqueness of the study lies on the way the women's empowerment has been defined. The study attempts to identify factors that affect *women's empowerment*. The underlying research question is, 'Are there any differences between borrowers and non-borrowers in terms of empowerment?'

The rest of the paper is structured as follows. Section 2 provides a wide range of literature covering many aspects of microcredit programme. Section 3 defines empowerment from an emancipation perspective. Section 4 describes data and its sources. Section 5 specifies the methodology and describes the model. Results are discussed in Section 6. A conclusion is drawn in the final section.

## **2 Background literature**

There is a wide range of studies available in the context of microcredit. Researchers have come up with very interesting findings; some studies argue that microfinance has very beneficial economic and social impacts (Hossain 1988, Otero and Rhyne 1994, Holcombe 1995, Hashemi *et al.* 1996). On the other hand, some have reservations against such optimism and point to the negative impacts of microfinance (Adams and von Pischke 1992, Montgomery 1996, Buckley 1997). Some researchers have a neutral view and have identified beneficial impacts but argue that microfinance does not assist the poorest, as is so often claimed (Hulme and Mosley 1996, Mosley and Hulme 1998).

There are quite a number of studies that have emphasised on the methodological issues used in microcredit literature. One of the most influential empirical studies that may be mentioned here is by Pitt and Khandker (1998). They address the bias that may arise due to self-selection of the borrower in the microcredit programme, which eventually leads to an overestimation of overall poverty reduction. Pitt and Khandker (1998) estimated the model using instrumental variables and have selected the variables in such a way that the independent variables do not correlate with the error term to resolve endogeneity problem. Hulme (2000), on the other hand, has also reviewed the methodological options for the impact assessment of microcredit. He examined the choice of conceptual frameworks and presented the following three paradigms of impact assessment: the scientific method, the humanities tradition and participatory learning and action. Since assessment of impact of microcredit programme is complex and entails several methodological challenges, Mosley (2000) suggested that this complex issue might be addressed via quasi-experiments method, multiple regression analysis or control-group method.

In terms of impact of microcredit on women's empowerment, there exist different views as well. Some researchers are sceptical about the positive effects of microcredit programme towards such an empowerment; most of the extant studies put forward a view that microcredit contributes towards women's empowerment (White 1992, Amin and Pabley 1994, Naved 1994). Hashemi *et al.* (1996) have found that the Grameen Bank and Bangladesh Rural Advancement Committee (BRAC) have had significant positive effects on women's empowerment. They have found microcredit has indeed reduced domestic violence in Bangladesh. However, Goetz and Sen Gupta (1996) argue that there is an inverse relationship between the loan amount and control (used as proxy for empowerment). They have found that control on loans diminishes beyond a threshold level of membership. Montgomery *et al.* (1996) have also expressed some reservations about the empowering effect of microcredit programmes. They argue that microcredit reinforces the existing gender discrimination and inequalities and contributes little to alter the social status of women.

In the literature of women's empowerment in relation to microcredit, different researchers have used different techniques to measure women's empowerment. Hashemi *et al.* (1996) created an 'empowerment index' composed of eight indicators. They arbitrarily chose a cut-off point of five and stated that if someone scores five points out of eight indicators, the person is empowered, otherwise not. To avoid selection bias they used respondents' demographic and socioeconomic characteristics such as age, education, relative wealth, religion, geographic division and number of surviving children, which may create heterogeneity problems. The unobserved heterogeneity problem is not addressed in the study.

Mizan (1993) has used a similar approach as that of Hashemi *et al.* (1996). He has used an index called the Household Decision Making (HHDM) Scale. Mizan has found that the number of years of borrowing from the Grameen Bank has a positive and significant effect on the HHDM score. Since only HHDM is used as the indicator of empowerment, this may be considered as a limitation of the study.

To assess women's empowerment, Zaman (1998) first divided the questions into three sections, i.e. 'women's ownership and control over assets', 'women's general and legal knowledge' and 'knowledge on fertility and mobility of the women'. In terms of ownership and control over resources, a list of common household assets is presented. All of these 'empowerment correlates' are binary variables.<sup>3</sup> Zaman (1998) has not constructed 'empowerment indices' to avoid problem of assigning subjective weights to different responses.

Ashraf *et al.* (2006) have defined women's empowerment as women's decision-making power. In the study they have used randomised controlled trials and examined whether access to products leads to an increase in women's decision-making power within the household. Using data from the Philippines they have found a positive impact of access to products and women's decision-making power.

Literature on microcredit has taken a different twist when researchers incorporated 'gender' along with women's empowerment. In a recent study, Armendàriz and Roome (2008) have argued that if microcredit programmes exclude men from access to subsidised finance, that may create some frictions and has rebound effects that diminish the supportive role women play for their spouses and wider household members in production of health and education. Mayoux (1999), Rahman (2001) and de Aghion and Morduch (2005) have similar views in relation to gender and women's empowerment. They have argued that the practice of exclusion of male members of the family from credit programme has proved to be counterproductive. In their views this can generate frictions within households, as men feel increasingly threatened in their role as primary breadwinners within the household.

Studies on women's empowerment in relation to microcredit vary not only in terms of impact of microcredit on women's empowerment but also in terms of the manner researchers have defined *women's empowerment*. It is

evident from literature that there is no coherent definition and/or measurement index of empowerment. It is apparent from the literature that the definitions of empowerment include control over assets (Goetz and Sen Gupta 1996, Montgomery *et al.* 1996); women's relative physical mobility, economic security, freedom from domination, political and legal awareness and participation in public protests and political campaigns (Hashemi *et al.* 1996, Zaman 1998, 2001, Banu *et al.* 2001); control over household resources (Amin and Pabley 1994); opportunity to generate income and control over income (Mustafa *et al.* 1996); handling of loan applications (Ackerly 1995); and participation in household decision-making (Mizan 1993, Kabeer 2001). However, it is also evident from literature that women's empowerment is defined as 'the capacity of women to become economically self-reliant with control over decisions affecting their lives and freedom from violence' (Rao and Kelleher 1995). Holcombe (1995) has defined women's empowerment as 'the sharing of control, and the entitlement and ability to participate in influencing decisions regarding the allocation of resources'. Sen (1997), on the other hand, has stated, 'Empowerment is about changes in favour of those who previously exercised little control over their lives'. Based on these literatures on women's empowerment as outlined here, it will then be necessary to construct the concept of women's empowerment to be used in the study.

### **3 Defining women's empowerment**

United Nations Population Information Network (POPIN)<sup>4</sup> has defined women's empowerment based on five components, which are as follows:

- Women's sense of self-worth.
- Their right to have access to opportunities and resources.
- Their right to have the power to control their own lives, both within and outside the home.
- Their right to have and to determine choices.
- Their ability to influence the direction of social changes to create a better social and economic order, nationally and internationally.

From the definitions of women's empowerment, as defined in the literature, we may visualise an empowered woman. An empowered woman is confident in her ability; she is capable of leading her life independently; she is socially as well as economically independent; she is opinionated, enlightened and has freedom from all sorts of domination; and finally she is someone who is capable of standing for her own rights. Now we may formulate a new definition of women's empowerment based on the above definitions:

Women's empowerment comprises women's education and knowledge to enhance her understanding about her surroundings, her ability to

control her life, freedom from domination by not depending on anyone else's income, her ability to participate in decision-making process, her capability to make independent decisions and finally her independence in terms of mobility.

These subjective attributes are difficult to measure. We have therefore used some proxies to measure different attributes of women's empowerment. We have identified, from the definition, the key features that represent women's empowerment. In the definition the key elements of women's empowerment are women's economic security, her ability to participate in decision-making processes, her control over assets, her mobility and finally her knowledge and awareness about her surroundings. In this study, we have used proxies for each type of attribute to define women's empowerment and to formulate an empowerment index.

Based on the above definition, in this study the following proxies are used to define women's empowerment: 'economic security index' (ESI), 'purchase decision index' (PDI), 'control over assets index' (COAI), 'mobility index' (MI) and finally 'awareness index' (AI) to develop an 'empowerment index'.<sup>5</sup>

### 3.1 Empowerment index (EI)

The latent variable empowerment (E) is measured through an index called empowerment index (EI). To calculate the EI, all indices such as ESI, PDI, COAI, MI and AI are added. The cut-off point decided here is three. Someone scoring three or more out of five indices is considered empowered and scores 1, otherwise 0.

This may be symbolically written as

$$\begin{aligned}\text{Empowerment (E)} &= (\text{ESI} + \text{PDI} + \text{COAI} + \text{MI} + \text{AI}) \geq 3, \\ \text{Empowerment Index (EI)} &= 1 \text{ if } E \geq 3, \\ &\text{otherwise } 0.\end{aligned}$$

In this study we have calculated EI for both borrowers and non-borrowers, investigated factors affecting women's empowerment and identified any differences in terms of empowerment between borrowers and non-borrowers.

## 4 Data

We have used primary data from borrowers of two major microcredit institutions in Bangladesh, such as the Grameen Bank and BRAC, collected through a structured questionnaire.<sup>6</sup> These two large institutions have got coverage all over the country. Based on different agro-climatic and socio-economic conditions we have selected three districts of Bangladesh to collect the data. The districts are Gazipur, Dinajpur and Chokoria. Gazipur is close to Dhaka, the capital city, and Dinajpur and Chokoria are chosen from far north and south parts of the country to have different socioeconomic effect. From each

districts five villages are chosen at random. The borrowers are selected in a cluster from each village. To avoid endogeneity, non-borrowers' data has been collected from non-programme villages. Non-borrowers are selected from non-programme villages to share the same socioeconomic and cultural background to provide a control group for comparison with borrowers. The samples of borrowers are randomly selected without replacement from the list of households available from the programmes' local office in each village. From all three districts 387 borrowers and 184 non-borrowers were interviewed through a structured questionnaire.

## 5 Methodology

In a similar study Pitt *et al.* (2003) have used panel data estimation to assess for women's empowerment. They have corrected *thana*-level heterogeneity by using Hausman and Breusch-Pagan tests on all empowerment factors. To reduce village-level heterogeneity they used conditional demands on a set of empowerment indicators. There is one more technique, i.e. comparison techniques that is often used in studies. The problem with comparison technique is to find two identical villages or households. To reduce heterogeneity bias in this study we used quasi-experimental approach by comparing microcredit borrowers with non-borrowers as control group selected from non-programme villages.

As we know, decision to participate in a microcredit programme is self-selective. This type of self-selection problem may be corrected through Heckman's two-stage correction procedure. Since no suitable instruments have been identified which would permit the use of techniques such as the Heckman procedure to correct this self-selection bias, we did not look at the causal impact of programme participation in this study.

### 5.1 Specification of the model

To identify the factors that affect empowerment we considered the following questions: (1) Does age of the female matter? (2) Does her education matter? (3) Does the spouse's age and education make any difference in terms of empowerment? (4) Does income of the household have any effect? (5) Can asset accumulation make a woman empowered? (6) Does women's empowerment depend on the locality where she resides?

After careful consideration of the aforementioned questions, we have identified factors that may affect women's empowerment. The factors are age of the female, age of the husband, education of the female, education of the husband, income of the household, assets of the household and the location where she resides.

According to theory, it is expected that younger women are more empowered; it is also expected that a young man would encourage his wife to be more empowered. We may therefore expect a negative coefficient of age of both male and female when regressed against the binary variable



empowerment index. Similarly, theory tells us that education has a positive impact on woman's empowerment. We may expect a positive coefficient for education of both male and female. We may also expect a positive coefficient of income and assets. In terms of location we expect a positive coefficient of  $DD_1$  (Gazipur), as Gazipur is close to the capital city Dhaka.

## 5.2 Specification of the variables<sup>7</sup>

The specifications of variables divided into different groups are as follows:

### *Demographic factors (DF)*

- Age of the female (borrower/non-borrower) (AFEM).
- Age of the male (husband of the borrower/non-borrower) (AM).
- Education of the female (borrower/non-borrower) (EFEM).
- Education of the male (husband of the borrower/non-borrower) (EM).

### *Economic factors (EF)*

- Income of the household (YH).
- Assets of the household (ASE).

### *Dummy variables (DV)*

- Borrower dummy (BD = 1 for borrowers, otherwise 0).
- District dummy ( $DD_1$  = 1 for Gazipur, otherwise 0).
- District dummy ( $DD_2$  = 1 for Dinajpur, otherwise 0).

## 5.3 The model

Recapping the whole story, we may now develop a model from above-mentioned variables and dummies. The latent variable 'empowerment' is measured by an index that is binary in nature. This index takes the value of 1 and 0 only. Therefore the probability of someone being empowered, as denoted by  $P(EI)$ , is shown by the following model:

$$P(EI_i) = \alpha_i + \beta_i AFEM + \delta_i AM + \gamma_i EFEM + \lambda_i EM + \mu_i YH + \pi_i ASE + \phi_i BD + \theta_i DD_1 + \varphi_i DD_2 + \varepsilon_{i\varphi} \quad (1)$$

where  $\beta, \delta, \gamma, \lambda, \mu, \pi, \phi, \theta, \varphi$  are the parameters of the variables, such as age of the female, age of the male (husband), education of the female, education of the male (husband), household income (total expenditure is taken as a proxy for income), household assets,<sup>8</sup> borrower dummy and both district dummies, respectively, of the  $i$ th female and  $\varepsilon_i$  is the error term.

## 6 Estimation results and discussion

Tables 6.1.1 and 6.1.2 provide the mean and percentages of all the indices used to calculate the EI. Table 6.1.1 shows the average and percentage

Table 6.1.1 Borrowers and non-borrowers' ownership, purchase decision, control, mobility and awareness indices according to districts

| Indices                         | Classification of the indices            | Gazipur  |              | Dinajpur |              | Chokoria  |              | Total    |              |
|---------------------------------|------------------------------------------|----------|--------------|----------|--------------|-----------|--------------|----------|--------------|
|                                 |                                          | Borrower | Non-borrower | Borrower | Non-borrower | Borrower  | Non-borrower | Borrower | Non-borrower |
| Economic security index (ESI)   | House/land                               | 31 (25)  | 1 (2)        | 9 (7)    | 0 (0)        | 3 (2)     | 0 (0)        | 43 (11)  | 1 (0.5)      |
| Purchase decision index (PDI)   | Productive asset                         | 76 (61)  | 37 (69)      | 80 (61)  | 36 (57)      | 71 (55)   | 22 (33)      | 227 (58) | 95 (52)      |
|                                 | Savings                                  | 78 (62)  | 22 (41)      | 71 (54)  | 36 (57)      | 79 (61)   | 33 (49)      | 228 (59) | 91 (49)      |
|                                 | Poultry/shop                             | 2 (2)    | 0 (0)        | 5 (4)    | 0 (0)        | 0 (0)     | 0 (0)        | 7 (2)    | 0 (0)        |
|                                 | House/land                               | 26 (21)  | 0 (0)        | 9 (7)    | 0 (0)        | 3 (2)     | 0 (0)        | 38 (10)  | 0 (0)        |
| Control over asset index (COAI) | Productive asset                         | 43 (34)  | 18 (33)      | 26 (20)  | 15 (24)      | 31 (24)   | 11 (16)      | 100 (26) | 44 (24)      |
|                                 | Savings                                  | 39(31)   | 9 (17)       | 25 (19)  | 16 (25)      | 32 (25)   | 16 (24)      | 96 (25)  | 41 (22)      |
|                                 | Poultry/shop                             | 2 (2)    | 0 (0)        | 5 (4)    | 0 (0)        | 0 (0)     | 0 (0)        | 7 (2)    | 0 (0)        |
|                                 |                                          | 75 (60)  | 21 (39)      | 38 (29)  | 17 (27)      | 47 (36)   | 23 (34)      | 160 (27) | 61 (33)      |
| Mobility index (MI)             | Generally on her own                     | 25 (20)  | 4 (7.5)      | 18 (14)  | 6.3 (10)     | 17 (16.8) | 5 (7.4)      | 60 (15)  | 15 (8)       |
|                                 | Occasionally on her own                  | 24 (19)  | 10 (18)      | 40 (30)  | 22 (35)      | 41 (39.4) | 17 (25.3)    | 105 (27) | 49 (27)      |
|                                 | Generally accompanied by others          | 21 (17)  | 8 (15)       | 35 (26)  | 15 (24)      | 37 (35.9) | 22 (32.3)    | 93 (24)  | 45 (24)      |
|                                 | Occasionally accompanied by others       | 38 (30)  | 15 (28)      | 23 (17)  | 14 (22)      | 24 (23.3) | 17 (25)      | 85 (22)  | 46 (25)      |
| Awareness index (AI)            | Affirmative responses from the questions | 84 (68)  | 34 (63)      | 81 (61)  | 40 (63)      | 81 (78)   | 43 (64)      | 246 (64) | 117 (64)     |
| Listens to news (radio/TV)      |                                          | 94 (75)  | 34 (63)      | 75 (57)  | 39 (62)      | 68 (52)   | 37 (55)      | 237 (61) | 110 (59)     |
| Number of observations          |                                          | 125      | 54           | 132      | 63           | 130       | 67           | 387      | 184          |

Note: Figures in parentheses show the percentage.

*Table 6.1.2* Empowerment index of borrowers and non-borrowers according to districts

| Districts' indices              | Gazipur   |              | Dinajpur |              | Chokoria |              |
|---------------------------------|-----------|--------------|----------|--------------|----------|--------------|
|                                 | Borrower  | Non-borrower | Borrower | Non-borrower | Borrower | Non-borrower |
| Economic security index (ECI)   | 68 (54.4) | 17 (31.5)    | 58 (44)  | 23 (37)      | 41 (32)  | 9 (13)       |
| Purchase decision index (PDI)   | 63 (50.4) | 24 (44.4)    | 52 (39)  | 25 (40)      | 49 (38)  | 26 (39)      |
| Control over asset index (COAI) | 75 (60)   | 21 (38.9)    | 38 (29)  | 17 (27)      | 47 (36)  | 23 (34)      |
| Mobility index (MI)             | 43 (34.4) | 13 (24)      | 54 (41)  | 31 (49)      | 60 (46)  | 23 (34)      |
| Awareness index (AI)            | 84.5 (68) | 33.8 (63)    | 81 (61)  | 40 (63)      | 81 (78)  | 42.7 (63.8)  |
| Empowerment index (EI)          | 81 (64.8) | 28 (51.6)    | 73 (55)  | 39 (62)      | 78 (60)  | 39 (58)      |

*Note:* Figures in parentheses show the percentage.

of all ownership items, items related to participation in decision-making process, control over assets and mobility indicators of all borrowers and non-borrowers of all three districts.

Out of the 125 borrowers in Gaspar, it is found that only 31 own land in their own name. This comprises 25% of the borrowers of Gazipur owning land or houses in their names.<sup>9</sup> The borrowers of Dinajpur own the second highest percentage of houses or land. Out of total borrowers only 11% of those sampled possess land or houses in their names and only 0.5% of non-borrowers possess their own land.

In terms of owning productive assets it is observed that non-borrowers of Gazipur are the highest in percentage ownership. In case of Dinajpur and Chokoria, borrowers own more productive assets than non-borrowers. The difference between borrowers and non-borrowers in terms of owning productive assets are quite low in Gazipur and Dinajpur but quite high in Chokoria.

In Gazipur and Chokoria borrowers have more savings than in Dinajpur. In Dinajpur the savings of borrowers and non-borrowers are not too far apart. It is observed that only 2 out of 125 borrowers possess a business or poultry in their own name. No non-borrower is found with any business in his/her name. When we summarise the ownership indicators, it is observed that the borrowers as a whole are better off compared to non-borrowers. In terms of districts, borrowers of Gazipur are better off compared with two other districts.

In Gazipur, both borrowers and non-borrowers participate more in the decision-making process of their property. Again, borrowers of Gazipur are better managers<sup>10</sup> of their savings by themselves. This savings-management ability is also found highest in Gazipur in percentage terms compared with the two other districts. In Dinajpur non-borrowers manage more of their savings compared with the borrowers' and in Chokoria savings management by both the groups is pretty much the same.

In Gazipur 60% borrowers are likely to keep to themselves the proceeds of the sale of their property (this is how 'control over assets' is measured). Both borrowers and non-borrowers of Gazipur have more control over their assets compared with the two other districts. Since Gazipur is close to Dhaka, there may be a capital-city influence for women having more control over assets. In Dinajpur and Chokoria, borrowers have more control over assets than non-borrowers.

In terms of women's mobility it is observed that borrowers of all three districts visit places on their own compared to non-borrowers. Among borrowers, women of Gazipur are more independent in terms of mobility than the other two districts. The mobility ranking from high to low is Gazipur, Chokoria and Dinajpur. Visiting places either generally or occasionally depends on someone's need. Therefore we do not distinguish women's mobility based on frequency of visit. It is observed from Table 6.1.1 that most women (both borrowers and non-borrowers) are more comfortable visiting places accompanied by someone. This may be a cultural norm.

Finally, from Table 6.1.1 it is observed that in the sample over 50% women of all categories are politically conscious and listen to radio/television news regularly. This information is gathered but not used in the analysis.

Table 6.1.2 shows the summary of Table 6.1.1 in terms of various indices. It shows the calculation of EI derived from all other indices by districts. From Table 6.1.2 it is observed that borrowers of all districts are more empowered in terms of ESI compared to non-borrowers.

Table 6.1.2 shows that among all districts, borrowers of Gazipur are more empowered in terms of ESI. The economic security ranking (high to low) is Gazipur, Dinajpur and Chokoria for borrowers, while for non-borrowers it is Dinajpur, Gazipur and Chokoria.

In terms of PDI, both borrowers and non-borrowers of Gazipur take a larger part in the decision-making process than the two other districts. This may be due to better facilities available in Gazipur (being near the capital city, Dhaka) compared with the two other districts. This made both borrowers and non-borrowers more empowered in terms of decision-making activities in Gazipur. However, in Dinajpur and Chokoria the difference between borrowers and non-borrowers is very small in terms of PDI, and it seems that non-borrowers are slightly better off compared to borrowers in these two districts.

It is observed from Table 6.1.2 that borrowers of all districts have more control over assets compared to non-borrowers. It is further observed that the difference in terms of control over assets between borrowers and non-borrowers is quite low in the districts of Dinajpur and Chokoria, while it is quite high in Gazipur.

As mentioned earlier, the analysis considered women's mobility only if they are capable of travelling to places independently. Women depending on someone for visiting places are not considered empowered in this

study. From Table 6.1.2 it is observed that non-borrowers of Dinajpur are the most mobile of all. We could not find any convincing explanation for such a result. It is interesting to see that women (both borrowers and non-borrowers) of Dinajpur and Chokoria are more mobile compared to Gazipur. While comparing borrowers with non-borrowers, it is observed that borrowers of Gazipur and Chokoria are more mobile compared to non-borrowers. In Dinajpur, non-borrowers are more mobile than borrowers. It is further observed that the difference between borrowers and non-borrowers in terms of mobility is higher in Chokoria than the two other districts.

It is observed from Table 6.1.2 that over 60% of women (both borrowers and non-borrowers) are politically aware and have better general knowledge. The borrowers of Chokoria are the most empowered in terms of the AI. Table 6.1.2 shows that the borrowers of Gazipur and Chokoria are more empowered in terms of the AI compared with non-borrowers of the same district. It is further observed that non-borrowers of Dinajpur have better general knowledge compared with borrowers of the same district.

Finally, Table 6.1.2 provides the EI. It is observed from the table that over 64% of borrowers and 52% of non-borrowers in Gazipur are empowered. It further shows that non-borrowers of Dinajpur are more empowered than borrowers in the same district. This finding may be explained through a casual observation that Dinajpur is culturally more advanced compared with two other districts. In Chokoria, 60% of borrowers and 58% of non-borrowers are empowered. The ranking of empowerment from high to low for borrowers is Gazipur, Chokoria and Dinajpur, while for non-borrowers it is Dinajpur, Chokoria and Gazipur.

### 6.1 Factors affecting empowerment: do non-borrowers benefit?

From the correlation matrix provided in the Table 6.1.3, we see that some variables, such as age of male and female, and education of male and female

*Table 6.1.3* Correlation matrix of the variables

|       | AFEM  | EFEM  | AM    | EM    | GHH   | NOE   | LNCRE | LNASE | TYH   | MAPFS | FAPFS | LNTE |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| AFEM  | 1     |       |       |       |       |       |       |       |       |       |       |      |
| EFEM  | -0.14 | 1     |       |       |       |       |       |       |       |       |       |      |
| AM    | 0.97  | -0.15 | 1     |       |       |       |       |       |       |       |       |      |
| EM    | 0.67  | 0.95  | -0.04 | 1     |       |       |       |       |       |       |       |      |
| GHH   | -0.23 | 0.14  | -0.25 | 0.21  | 1     |       |       |       |       |       |       |      |
| NOE   | 0.30  | -0.12 | 0.29  | -0.12 | -0.10 | 1     |       |       |       |       |       |      |
| LNCRE | 0.27  | -0.07 | 0.28  | 0.02  | -0.12 | 0.24  | 1     |       |       |       |       |      |
| LNASE | 0.34  | 0.13  | 0.32  | 0.2   | -0.01 | 0.20  | 0.43  | 1     |       |       |       |      |
| TYH   | 0.06  | 0.05  | 0.03  | 0.12  | 0.05  | 0.04  | 0.07  | 0.15  | 1     |       |       |      |
| MAPFS | 0.31  | -0.03 | 0.31  | 0.07  | -0.05 | 0.21  | 0.17  | 0.24  | 0.00  | 1     |       |      |
| FAPFS | 0.03  | 0.12  | 0.03  | 0.07  | -0.07 | -0.03 | 0.09  | 0.09  | -0.09 | 0.02  | 1     |      |
| LNTE  | 0.543 | 0.124 | 0.52  | 0.21  | 0.04  | 0.20  | 0.21  | 0.57  | 0.12  | 0.24  | 0.003 | 1    |

are highly correlated. We have, therefore, estimated the model using male age/education and female age/education in separate equations. Equation (1) is estimated using probit<sup>11</sup> estimation. Since the EI is binary in nature, probit estimation is used to regress the derived indices on various factors. It is assumed that the estimation error term of the probit model is normally distributed. The STATA 8.0 statistical package is used to estimate the model. White (1980) corrected standard errors<sup>12</sup> are used to allow for heteroscedasticity.

To find out the factors affecting empowerment, firstly, we divided the total sample according to two groups – borrowers<sup>13</sup> and non-borrowers – to see if these two groups are different in terms of empowerment. We also want to determine if there is any difference between women of different districts in terms of empowerment. Taking into consideration the fact that the districts are not identical in all attributes, we have considered district dummy in the equation. Along with that we have used the quadratic term of income to see if the quadratic term fits better for the model. We have also used total monthly expenditure as a proxy for income. After adding the quadratic term and district dummies the model is as follows:

$$P(EI_i) = \alpha_i + \beta_i AFEM + \gamma_i EFEM + \mu_i YH + v_i (YH)^2 + \theta_i DD_1 + \phi_i DD_2 + \varepsilon_i. \quad (2)$$

We have estimated Equation (2) separately for borrowers and non-borrowers. Table 6.1.4 shows the estimation results of the two groups separately. White corrected standard errors are used to allow for heteroscedasticity and goodness of fit is measured by the Wald chi-square ( $\chi^2$ ) test. The output from the logistic regression model provides the pseudo  $R^2$ , which is a measure of improvement to fit in a model due to independent variables and is also reported in the table.

*Table 6.1.4* Probit model: factors affecting empowerment index (borrowers and non-borrowers)

|                         | Borrowers        | Non-borrowers  |
|-------------------------|------------------|----------------|
| Constant                | 1.46*** (3.82)   | 1.89*** (2.87) |
| Age of the female       | -0.03*** (-4.81) | -0.03 (-3.20)  |
| Education of the female | 0.07*** (3.47)   | 0.02 (0.59)    |
| Household income        | -0.00 (-0.07)    | -0.00 (-0.83)  |
| Income squared          | 0.00 (0.43)      | 0.00 (0.79)    |
| District dummy 1        | 0.11 (0.67)      | -0.07 (-0.08)  |
| District dummy 2        | -0.18 (-1.06)    | -0.02 (-0.08)  |
| No. of observation      | 387              | 184            |
| Wald $\chi^2$           | 47.74            | 19.24          |
| Pseudo $R^2$            | 0.11             | 0.09           |

\*\*\*Significant at 1% level, \*\*significant at 5% level and \*significant at 10% level; figures in parentheses show the z-values.

From Table 6.1.4 it is observed that the age of borrowers is significant and negative. It is a significant factor in determining women's empowerment, but it affects empowerment negatively. The sign of the coefficient for both borrowers and non-borrowers is found negative. In other words, the estimation results suggest that younger women are more empowered. Further, education of the borrowers is found significant and positive. This implies that education of the borrower affects empowerment in a positive way. This is a reflection that the education plays an important role in making borrowers empowered.

Since the quadratic term is not found significant, we dropped the variable 'income-squared' in our following estimation. We used log-transformed 'income' and 'assets' variable instead to see whether the model fits in a better way. Now instead of separating the sample into two groups (borrowers and non-borrowers), we would like to determine the effect of factors for the sample as a whole. We therefore considered borrower dummy and district dummy to determine whether there is any difference between borrowers and non-borrowers and the districts, respectively. District dummy is calculated as  $DD_1 = 1$  for Gazipur, otherwise 0, and  $DD_2 = 1$  for Dinajpur, otherwise 0. Table 6.1.5 shows the estimation results of Equation (1) for the total data set using log-transformed variables for income and assets.

## 6.2 Factors affecting empowerment: who benefits?

We pooled the whole data set to estimate Equation (1). Table 6.1.5 shows the estimated results of Equation (1) considering all the variables. Due to the multicollinearity problem, we did not consider age/education of male and female together in the same equation.

*Table 6.1.5* Probit model: factors affecting empowerment index (pooling full data set)

|                         | Equation 1       | Equation 2       | Equation 3       |
|-------------------------|------------------|------------------|------------------|
| Constant                | -0.182 (-0.17)   | -0.18 (-0.17)    | 0.03 (0.03)      |
| Age of the female       | -0.02*** (-3.88) | -0.03*** (-3.90) | —                |
| Education of the female | 0.04** (2.29)    | 0.04** (2.30)    | —                |
| Age of the male         | —                | —                | -0.03*** (-4.09) |
| Education of the male   | —                | —                | 0.05*** (2.73)   |
| Log of income           | 0.03 (0.28)      | 0.04 (0.29)      | 0.03 (0.19)      |
| Log of assets           | 0.07 (1.32)      | 0.08 (1.32)      | 0.08 (1.43)      |
| Borrower dummy          | 0.001 (0.01)     | —                | —                |
| District dummy 1        | 0.59*** (2.90)   | 0.50*** (2.90)   | 0.49*** (2.88)   |
| District dummy 2        | 0.21 (1.30)      | 0.21 (1.31)      | 0.23 (1.44)      |
| No. of observation      | 379              | 379              | 379              |
| Wald $\chi^2$           | 32.82            | 32.82            | 37.26            |
| Pseudo $R^2$            | 0.06             | 0.07             | 0.07             |

\*\*\*Significant at 1% level, \*\*significant at 5% level and \*significant at 10% level; figures in parentheses show the z-values.

The first column of Table 6.1.5 shows the estimation result of Equation (1) considering all the variables. The results are shown as equation 1 (column 1 in Table 6.1.5). The estimation result, as depicted in equation 1, shows that age of the female is significant and affects empowerment negatively. Education of the female is significant and affects empowerment positively.

Equation 1 of Table 6.1.5 further shows that Gazipur is significantly different from other two districts. Since Gazipur is close to Dhaka, the capital city, it may be perceived that there may be some capital city influence on Gazipur that makes women more empowered in that district. It may be because the people of Gazipur have better access to all facilities that may bring higher standard of living as well as empowerment to women in that district.

From the estimation results of equation 1 in Table 6.1.5 we see that the borrower dummy is not significant. We therefore decided to drop this variable and estimate the model keeping age/education of male and female in separate equations. Equations 2 and 3 are estimated using female and male age/education separately after dropping borrower dummy. The results of equations 2 and 3 are provided in the second and third columns of Table 6.1.5, respectively.

Table 6.1.5 further shows that the coefficient of age of male is significant and negative. This is an interesting finding. It may be interpreted that a younger male (male counterpart could be husband or father) encourages a female to be empowered. The table also shows that the male partner's education affects women's empowerment significantly and positively. There could be a different interpretation of the sign of coefficient of age/education of the male counterpart. This could also be due to the correlation between female age/education with male age/education.

### **6.3 Factors affecting empowerment: does level of income matter?**

From Tables 6.1.4 and 6.1.5 we observed that the coefficients of 'income' or 'log of income' variables are not significant. We have so far overlooked the possibility that income and assets variables could be correlated. We have therefore dropped the income variable from Equation (1) and estimated the model considering log-transformed assets alone as an economic variable. We have used age/education for male and female in separate equations. We have divided the households into three equal groups based on their income level to determine whether their income level has any impact towards women's empowerment. We used two income dummies,  $DY_1$  and  $DY_2$ ;  $DY_1 = 1$  for low-income group and 0 otherwise, and  $DY_2 = 1$  for middle-income group and 0 otherwise. After adding the dummies the model is as follows:

$$P(EI_i) = \alpha_i + \beta_i AFEM + \gamma_i EFEM + \lambda_i LnASE + \theta_i DY_1 + \phi_i DY_2 + \varepsilon_i \quad (3)$$

We estimated Equation (3) for the whole group (borrowers and non-borrowers). Equations 3 and 4 (columns 1 and 2 of Table 6.1.6) show the estimation results of Equation (3) for females and males, respectively.



*Table 6.1.6* Probit model: factors affecting empowerment index (based on different income level households)

|                         | Equation 3       | Equation 4       |
|-------------------------|------------------|------------------|
| Constant                | 0.28 (0.55)      | 0.38 (0.72)      |
| Age of the female       | -0.03*** (-3.94) | —                |
| Education of the female | 0.04* (1.75)     | —                |
| Age of the male         | —                | -0.03*** (-4.07) |
| Education of the male   | —                | 0.04** (2.33)    |
| Log of assets           | 0.11* (1.94)     | 0.11** (1.97)    |
| Low-income dummy        | 0.02 (0.11)      | 0.04 (0.21)      |
| Middle-income dummy     | -0.33** (-2.01)  | -0.32* (-1.94)   |
| No. of observations     | 387              | 387              |
| Wald $\chi^2$           | 26.94            | 34.63            |
| Pseudo $R^2$            | 0.06             | 0.07             |

\*\*\*Significant at 1% level, \*\*significant at 5% level and \*significant at 10% level; figures in parentheses show the z-values.

From Table 6.1.6 we found that the age of female is significant. Education of female is significant at the 10% level. The coefficient of age of male is found negative and significant. This implies that a younger male also encourages a female to be empowered. The coefficient of education for both male and female is found positive. This reinforces the importance of education for both male and female in bringing women's empowerment.

Table 6.1.6 further shows that after dropping the income variable (as one of the economic factors), we found that the coefficient of assets is positive and significant at 5% and 10% levels. Families with more assets are definitely privileged, which may contribute towards better facilities to empower female in the family. Furthermore, it is observed that the middle-income-group household is significantly different (at 5% and 10% levels) from low- and high-income-group household. There is no plausible explanation for the negative coefficient of this income dummy. There may be some data discrepancies (one of the limitations of primary data), which prevent a reasonable explanation here.

## 7 Conclusions

This paper, first of all, defines women's empowerment from an emancipation perspective based on how it has been defined by previous researchers. The subjective term 'women's empowerment' is measured via some proxies. The purpose of the study is to find out, firstly, differences in women's empowerment between microcredit borrowers by comparing with non-borrowers used as the control group and, secondly, identify factors that may have affected women's empowerment.

It is observed from the analysis that borrowers, as a whole, are better off in terms of economic security index (ESI) in all the three districts. However, by

looking at the individual figures it appears that non-borrowers of Dinajpur and Gazipur have more savings and productive assets, respectively, compared with the borrowers. There is no plausible explanation for such a result. In terms of decision-making process, the overall picture shows that borrowers are better off. In terms of mobility it appears that females of all the districts are more comfortable going out with someone instead of going alone. This could be a cultural norm. From careful observation it appears that borrowers of Chokoria are most mobile. In Dinajpur it appears that non-borrowers are more mobile compared to borrowers.

The overall picture shows that in terms of awareness there is no difference between borrowers and non-borrowers. However, the individual depiction shows that borrowers of Gazipur and Chokoria are more empowered in terms of general knowledge compared with non-borrowers, but not in Dinajpur.

In terms of the empowerment index (EI), it is observed that borrowers of Gazipur are the most empowered compared with non-borrowers as well as the other districts. When comparing borrowers with non-borrowers of all the districts, it appears that the borrowers of Gazipur and Chokoria are more empowered than non-borrowers, whereas in Dinajpur non-borrowers are more empowered than borrowers.

In this study we have tried to find out the factors that may affect women's empowerment. It is observed from the analysis that the age of female has negative effects on empowerment. That implies that younger females are more empowered. We have also found that the education of female affects empowerment positively – this shows the importance of education towards women's empowerment. The most interesting finding is the age and education of the male partner. It appears that young and educated males encourage females to be more empowered. We further observed that assets are positively related to women's empowerment.

In this study we have found that Gazipur is significantly different from the two other districts in terms of women's empowerment and also that middle-income-group borrowers are different from low- and high-income groups. The estimation result (insignificant borrower dummy) shows that there is no significant difference between borrowers and non-borrowers in terms of empowerment. One interesting conclusion may be derived from this finding; i.e. intensive microcredit intervention in the rural economy is leaving a demonstration effect on every person, thereby making even non-borrowers as empowered as borrowers. Since there are no proper instruments identified to control the selection bias and there is also a lack of non-availability of control group identical to those who obtained microcredit, the results of this study need to be qualified.

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## Notes

1. The *poverty line* is the level of income below which one cannot afford to purchase all the resources one requires to live. People who have an income below the poverty line by definition have no discretionary disposable income (Sen 1976).
2. Power distance is a cultural index derived by sociologist Geert Hofstede (2001). It measures how much respect a culture has for the authority. The Arabic-speaking nations, Latin America, Russia and nearly all of Asia are high in power distance. Most of Europe, Canada, Australia and Israel are low in power distance. Japan and Mediterranean Europe fall in the middle. In a high-power-distance culture, it's acceptable for a supervisor to display his authority, while in a low-power-distance culture, supervisors are expected to treat employees respectfully.
3. The responses are transformed into binary variables wherever necessary; for instance, 'general knowledge' example discussed above, the 'incorrect' and 'don't know' responses are merged into one category.
4. See <http://www.un.org/popin>.
5. Detailed derivations of each individual index would be provided upon request.
6. Questionnaire is available for review on request.
7. Correlation matrix of the variables is provided as Table 6.1.3.
8. Assets are physical assets such as furniture, radio, television and other household items except land and houses valued at market price.
9. The reason for borrowers having land or house in their own name could be due to the new rule introduced by the Grameen Bank that if a person has to take a loan for housing or purchasing a piece of land, his wife's name has to be included in the property. In general, almost all loans are granted towards females.
10. By the term 'managing savings' we considered that the female can save her money on her own will and spend from the savings, if necessary, without consulting her male counterpart.
11. An alternative to logistic regression analysis is probit analysis. The term 'probit' was introduced in the 1930s by Chester Bliss and stands for probability unit. Probit estimation uses the cumulative normal probability distribution (Gujarati 1992, p. 356).
12. White (1980) has derived a heteroscedasticity consistent covariance matrix estimator that provides correct estimates of the coefficient covariance in the presence of heteroscedasticity of unknown form (Gujarati 1992, p. 449).
13. We know that the decision to participate in a microcredit programme is self-selective. This type of self-selection problem may be corrected through Heckman's two-stage correction procedure. The problem with the Heckman procedure is to identify suitable instruments. Since no suitable instruments have been identified which would permit the use of Heckman procedure to correct this self-selection bias, we did not look at the causal impact of programme participation in this study.

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